The Australian and New Zealand Journal of Surgery

APRIL, 1944.

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Royal College of Surgeons of England.

JACKSONIAN PRIZE.

THE Council of the Royal Australasian College of Surgeons has been advised by the Council of the Royal College of Surgeons of England that the subject chosen for the Jacksonian Prize for the year 1945 is as follows: "Bone Grafting in Surgery: Its Indications, Methods and Results." Full details governing the conditions of the prize will be announced at a later date.

Editorial Notices.

ALL articles submitted for publication in this journal must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

Authors are requested to submit two typescript copies of all articles.

References to articles and books should be carefully checked. In a reference the following information should be given without any abbreviation: initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given, with full date in each instance.

When illustrations are required, good photographic prints on glossy gaslight paper should be submitted. Line drawings, charts, graphs and so forth should be drawn on thick white paper in indian ink. Authors who are not accustomed to prepare drawings of this kind, are invited to seek the advice of the Editor if they are in any doubt as to the correct procedure. Skiagrams can be reproduced satisfactorily only if good prints or negatives are available.

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THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY

Registered at the General Post Office, Melbourne, for transmission by post as a periodical.

VOL. XIII. APRIL, 1944. No. 4.

DANGERS AND COMPLICATIONS IN THE TREATMENT OF HÆMORRHOIDS.[1]

By T. H. ACKLAND,
Major, Australian Army Medical Corps.

No aspect of medicine is more important than the safe and satisfactory management of common conditions; nor can we overlook the desirability that the final result shall compare favourably with the untreated state. The treatment of hæmorrhoids is so frequently required in general surgical practice that a study of the risks incurred deserves closest consideration. Since the incidence of unpleasant sequelæ appears low when expressed in terms of percentage of total numbers treated, care must be taken that a false impression is not obtained. Thus, even though it is stated that sloughing follows injection in only 1% of cases, it must be remembered that the actual number of patients affected by this complication is by no means small.

A survey of available literature shows that attention has been paid to the likelihood of stricture following Whitehead's operation, and more recently it has been recognized that "stripping" operations tend to produce a similar result. But there have been relatively few reports of the dangers of improperly performed injections.

There is a widely held belief that the injection of oil for hæmorrhoids is a procedure which is never associated with serious complications; but actually this is not the case. I have personal knowledge of three patients upon whom colostomy was performed for extensive rectal necrosis which followed injection, while lesser degrees of sloughing not infrequently cause several days of pain and disablement. The most complete numerical survey of this subject has been made by Kilbourne,[1] who collected the results in 62,910 cases from 293 proctologists in the United States, Great Britain, Germany and France. He published the figures shown in the accompanying table.

Sequelæ of Treatment for Hæmorrhoids.

Observation.	Surgery.	Injection.
Mortalities	0·032%	0
Sloughing following injection ..	——	1·09%
Hæmorrhage	0·573%	0·279%
Stricture	0·22%	0·02%
Recurrence	0·5%	10·0%

[1] Accepted for publication on March 1, 1944.

The figure of 0·22% cannot be accepted as a true statement of the frequency of stricture formation after operation. Actually, no less than 9% of patients are affected by some degree of this complication.

INJECTION TREATMENT.

Four degrees of hæmorrhoids are commonly recognized, although sometimes the third and fourth are combined.

First Degree.—The piles are small and do not prolapse. Bleeding accompanying each act of defæcation is the only symptom.

Second Degree.—The piles are rather larger and, in addition to bleeding, protrude during defæcation. However, when straining is discontinued they spontaneously disappear.

Third Degree.—The piles protrude, but must be replaced by manual pressure.

Fourth Degree.—Prolapse occurs whenever the upright posture is adopted or with the slightest exertion such as coughing or sneezing.

Hæmorrhoids of the third and fourth degrees are often tough and fibrous and covered by thickened mucous membrane or even skin which is produced by metaplasia when continual extrusion occurs. Thus bleeding is less commonly the patient's complaint.

Injection, first introduced by Blanchard in 1866, is especially suitable for first degree piles. Hæmorrhage is much more likely to be controlled than is protrusion; indeed, bleeding will usually cease forthwith after one properly placed injection. The treatment of large protruding piles with high submucous injections is unsatisfactory, and should be employed only when operation is refused. A poor general condition of the patient is not necessarily an indication to avoid operation, which can be satisfactorily performed under local anæsthesia.

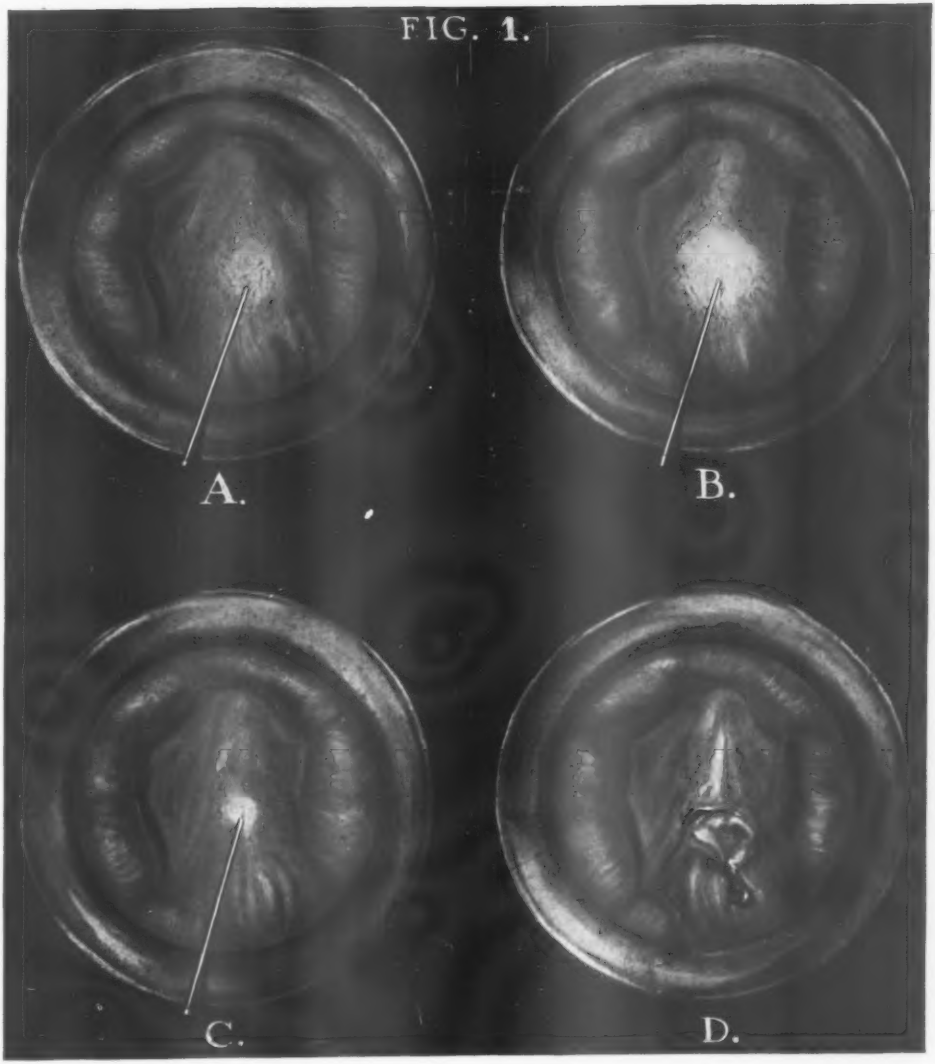
Strangulated, thrombosed, infected or ulcerated hæmorrhoids should never be injected, but rather treated conservatively. The coexistence of inflammatory states such as abscess or fistula is also a contraindication to injection. External hæmorrhoids should never be injected. Such a procedure invariably results in great pain, and usually causes sloughing of the overlying skin with the formation of an anal ulcer which takes some time to heal.

Gabriel[2] has described the correct technique of injection, with the use of 5% phenol in almond oil. Maize or olive oil is equally satisfactory. He has stressed the importance of placing the injection in the submucous plane, not at, but above, the level of the upper limit of each hæmorrhoid. This point is the ano-rectal ring, the sphincteric arch raised by the pubo-rectalis muscle. Injections placed lower, beneath the mucous membrane overlying the pile itself, will not only be less effective, but will cause more discomfort to the patient.

To reach the desired level, all short stubby proctoscopes are useless, especially in stout subjects with a funnel-shaped anal entrance. Even less suitable are proctoscopes with side windows into which the hæmorrhoid is intended to prolapse for injection. The ideal instrument is three inches long and preferably self-illuminated. Gabriel advises the injection of one hæmorrhoid only at one session, but many proctologists find no disadvantage in injecting all three. It is wise to explain to the patient that a feeling of fullness in the rectum will be experienced for a short time, and that when next the bowels are opened a little more blood than usual may be noticed. One may then safely promise that the bleeding will cease.

The surgeon must begin without any fixed intention concerning the quantity of oil he is to inject into each suprahæmorrhoidal area. The criterion

FIG. 1.



A.: The "striation sign" which is seen when a correct amount of oil has been injected. Capillaries stand out against pale yellow background.

B.: The appearance produced by injecting too much oil. The background is now yellowish-white and blood has been forced out of the capillaries. Ulceration is likely to occur.

C.: An injection placed too superficially, in an intramucosal plane. A dead white area appears at once, and ulceration may follow.

D.: An injection ulcer.

must be the production of the "striation sign". This appearance, the result of the injection of the correct amount of oil, is shown in Figure I, A. Three cubic centimetres are commonly required to produce it, but the amount which is necessary may vary between 0·5 and 5·0 cubic centimetres, depending upon the degree of laxity of the rectal mucosa. In some cases, when the treatment is being repeated for the second or third time, even a very small amount of injected oil may produce ischæmic ulceration.

Complications of Injection.

Injection Slough.—Figure I, B, illustrates the appearance presented by the injection of an excessive amount of oil.

The striation sign has disappeared with the forcing out of blood from the mucosal vessels. The yellowish-white raised area is now likely to ulcerate, not for chemical but for physical reasons. One must realize the added likelihood of this occurrence when previous injections have been given and the mucous membrane is perhaps tightly bound down. The surgeon must then be on his guard, and induration may be detected as the needle penetrates the mucosal layer; but most important of all is an eye watchful for the colour changes as injection proceeds, and assisted by good illumination.

Injection slough may also be produced by placing the injection too superficially. If a dead white area appears as soon as the injection is commenced, it is being wrongly placed in an intramucosal plane. Ulceration will occur if the necessary correction is not made at once. The appearance produced by an intramucosal injection is shown in Figure I, C.

Small ulcers, caused in either of these two ways, do not cause a great deal of trouble and are probably much commoner than is usually believed. If they are known to be present the patient should remain in bed and the area should be swabbed daily with a mild antiseptic such as a 2% solution of mercurochrome. Healing usually occurs in from four to seven days.

Occasionally, however, the ulcerated area is aggravated by superadded infection, and becomes much more extensive. A sloughing proctitis results, with great pain, tenesmus, the frequent passage of blood and mucus, and severe toxæmia. Yaker[37] has written a detailed account of one case of sloughing in which continued secondary hæmorrhages nearly caused death. Morgan[40] refers to a worse case in which, nineteen days after injection, the lower part of the rectum and anus had completely sloughed away. The patient was finally left with four anal orifices and no control of his bowels or bladder. It is not stated what was the nature or quantity of the injection material employed.

Reference has already been made to three patients who required colostomy for a condition such as this. On each occasion 5% phenol in oil was the substance which had been injected. The following is a typical case history in which the final result was stricture of the rectum and a permanent artificial anus:

C.C., aged thirty-three years, had suffered for years from piles, which had been injected one year before the present occasion. He was now admitted to hospital a fortnight after having injections into two piles. He had been running a swinging temperature, and was passing a good deal of blood and mucus with his stools. He was also complaining of severe rectal pain.

On examination he was found to be incontinent, with a blood-stained discharge dribbling from his anus, and ulceration was visible on the right side of the anal margin. Digital examination was extremely painful and two deep ulcers with indurated edges were felt. Proctoscopic examination confirmed the presence of these and showed the surrounding rectal mucosa to be acutely inflamed and overlaid with mucus, pus and blood. The patient's rectum was washed out every four hours with saline solution and cod liver oil, and the administra ion of sulphapyridine was begun. He was also placed on a non-residual diet and given paraffin, half an ounce, twice daily. Four days

later he was still incontinent, passing a great deal of blood *per rectum*, and looked very ill. His temperature was in the vicinity of 101° F. and the hæmoglobin level had fallen to 65%. On the next day left iliac colostomy was performed. During the following week all symptoms gradually abated, but persisting rectal infection and some continuance of bleeding caused a further lowering of hæmoglobin value to 60%. A transfusion of one pint of blood was given. Steady improvement followed, both in the rectum and in the patient's general condition. But healing of the ulcerated area was accompanied by such marked stricture formation that one month later the anal canal would admit only the tip of the examining finger.

At the present time, twelve months afterwards, the condition is unaltered and the artificial anus would appear to be a permanent necessity.

It is likely that in this case careful attention was not paid to the colour changes of the mucous membrane while the injection was being made. The previous treatment probably caused firm adherence of the mucosa to the underlying tissues, so that on the occasion under consideration only one or two cubic centimetres, or even less, should have been injected. Ischæmic necrosis was followed by sloughing and spreading infection.

It may therefore be concluded that injection treatment of hæmorrhoids carries with it a small but appreciable degree of danger of this complication, which must be minimized by accurate knowledge of the causes of such disaster as has been described, and by careful performance of the correct technique.

Fibrous "Tumours" Following Injection.—Rosser Curtice[5] describes the formation of fibrous "tumours" in the anal canal resulting from oil retention, and is of the opinion that this occurrence is more likely when cotton seed oil is used. A firm but non-tender area may sometimes be felt by digital examination after a large injection. This is usually the result of a widespread submucous thrombosis. It causes no symptoms and gradually disappears.

I have never seen indurated areas persist when almond oil, maize oil or olive oil has been used.

Hæmorrhage.—Immediate bleeding from the needle puncture is an inconvenience rather than a danger, but at times it may be very profuse. If the injection of oil is steadily continued as the needle is being withdrawn a very small intramucosal bleb results. This produces a satisfactory "sealing-off", and is a useful refinement of technique.

Secondary hæmorrhage does not occur apart from ulceration and sloughing.

Other Less Common Sequelæ.—Embolism following injection has been reported by Newman[6] and Marshall,[7] but a study of these case reports is not convincing and one may conclude that this must be an extremely rare complication.

A carelessly placed injection may result in serious injury to neighbouring structures. Recto-vaginal fistula has resulted from an extension of the process of ulceration and necrosis which has already been described. Similarly, a prostatic or periprostatic abscess may occur with associated vesiculitis or epididymitis. I have recently observed a case in which hæmaturia followed a properly performed injection. This was possibly due to poisoning from carbolic acid, which may produce the same symptom when it is absorbed from a dressing. Lesser degrees of hæmaturia from this cause may follow injection more commonly than is supposed.

OPERATIVE TREATMENT.

Operative treatment of hæmorrhoids was practised by the ancients. Hippocrates performed excision, and Galen ligated the base of each internal hæmorrhoid, allowing the whole to slough away. In later years many operations were introduced, most of which have proved to be unsatisfactory.

Whitehead's Operation (1882).

No technique of hæmorrhoidectomy now has fewer followers than Whitehead's operation, so likely is stricture to result from the uninterrupted ring of granulations which is produced. Almost all writers agree upon this matter, but it is still stated by some—for example, Darling[8]—that Whitehead's is the operation of choice when internal hæmorrhoids are complicated by a considerable degree of mucosal prolapse. It is difficult to understand the reason for this advice, since these cases can be quite satisfactorily treated by ligation in three masses. This is also the method to be recommended when prolapse of rectal mucosa is not associated with hæmorrhoids.

Clamp and Cautery.

The clamp and cautery operation was introduced by Cusack, of Dublin, and is still performed by some surgeons; but increasing recognition of its serious drawbacks has led to abandonment of the procedure in most countries. The removal of hæmorrhoidal tissue is seldom complete—secondary piles remain and subsequently increase in size. Skir and Marino[9] have shown that post-operative stricture formation is nearly three times as common after use of the clamp and cautery as after ligature and excision. Finally, very severe post-operative pain occurs if skin is included in the clamp. Strangely enough, some who no longer perform this operation for ordinary cases, still commend it when piles are thrombosed and grossly infected. In such circumstances one should never operate, as serious spreading ulceration is likely to result. Moreover, on account of the prolapse and surrounding œdema, it is impossible to judge accurately how much tissue is being removed.

When internal hæmorrhoids are prolapsed and thrombosed, and perhaps ulcerated and sloughing, they should be treated conservatively by recumbency, frequent irrigations with eusol or "Dettol" and antiseptic compresses of lead lotion or a one in 2,000 aqueous solution of perchloride of mercury. The usual elevation of the foot of the bed probably makes little contribution to the satisfactory result which ensues. Spontaneous cure is not infrequently seen after resolution is completed. Failing this, treatment by high submucous injections or even operation may be required some weeks later.

Excision and Suture.

All operations which include oversewing of raw areas at the anal margin are violations of sound surgical principles in that the area oversewn is infected. Abscess formation, with the possibility of consequent stricture, becomes a more likely complication.

Ligature and Excision.

Early in the nineteenth century the operation of ligation was modified by Salmon, the English proctologist who founded Saint Mark's, London, the world's first rectal hospital. Salmon made an incision around the base of the hæmorrhoid, but did not excise the whole mass.

Today no discussion of the details of an operation for hæmorrhoids or *fistula in ano* should be commenced without a study of the work of Milligan and Morgan[10] on the detailed anatomy of the anal canal. No more important contribution has ever been made to the surgery of this region. The anatomical operation of ligature and excision which was subsequently planned by these writers[11] is the greatest refinement so far reached in the technique of hæmorrhoidectomy.

Only too frequently operations for removal of piles are left to be carried out by house surgeons who are in ignorance of such fundamental knowledge as: the demarcations of the external and the internal hæmorrhoid, how much

external pile may safely be removed, the situation of the longitudinal muscle and the internal sphincter, and the causes of skin and mucous strictures.

Hæmorrhoidectomy is not a minor operation, but it is often lightly undertaken in private practice under bad conditions of preparation, assistance and nursing. The result has been that patients have a wide knowledge of the unfavourable results which may occur.

Milligan's operation, if carefully performed, will be followed by fewer complications than any other. All serious consequences except secondary hæmorrhage are due to faulty technique.

COMPLICATIONS OF LIGATURE AND EXCISION.

Hæmorrhage.

Hæmorrhage is practically the only cause of death after hæmorrhoidectomy. In Kilbourne's[11] figures the frequency of its occurrence with a fatal result was 0·032%.

Immediate or Reactionary Hæmorrhage.—Any of three separate causes may be responsible:

(*a*) The ligature may be tied too loosely. If catgut is used, it is easy to allow the first knot to slip while the second is being tied. Almost the only material upon which very great strength may be used is hollow-woven silk. This excellent material is now very difficult to procure. Transfixion is unnecessary even for bulky piles if such silk is used and also is undesirable because of the thickness of the ligature. As an alternative, strong chromicized catgut number 2 is satisfactory if transfixion is performed and a "surgeon's knot" employed. Moreover, only one variety, of tensile strength known to the operator, should be used.

(*b*) The points of the artery forceps which are drawing down the hæmorrhoid may be included in the ligature. When the forceps are removed the tie is left loose and hæmorrhage will occur. If these forceps are always removed when the first knot is being tightened, an accident of this nature is impossible.

(*c*) The hæmorrhoidal masses may be cut off too close to the knot, with the result that the vascular stump slips through the ligature. This temptation for overneatness must be resisted. The hæmorrhoids are excised after ligation only for reasons of cleanliness, and it is better to err on the side of safety. However, all of the skin tag and two-thirds of the internal pile may usually be cut away. A tube should always be left in the rectum after hæmorrhoidectomy to ensure that a reactionary hæmorrhage will not be concealed in the rectum and colon.

In regard to treatment, when hæmorrhage occurs while the operation is still in progress, an attempt should be made to secure the bleeding points. But since a properly performed operation involves ligating, at the anal margin, a point on a blood vessel which is normally at least one and a half inches higher up, its retreat to this level may render the tying of a ligature difficult or impossible. In such an emergency one should resort to the highly satisfactory plugging method first described by Lockhart-Mummery.[12] When the hæmorrhage is reactionary, it is wise to search carefully for a bleeding point which may be tied, the patient being anæsthetized and placed in the lithotomy position; but in most of these cases, as in all cases of secondary hæmorrhage, plugging (*vide infra*) is necessary.

Secondary Hæmorrhage.—While primary and reactionary hæmorrhage should never occur, secondary bleeding is not altogether avoidable. The most likely time for its occurrence is early in the second week of convalescence. The rectum cannot be rendered surgically sterile, and infection of the ligated

pile stumps will in a small number of cases cause erosion of vessels. Nevertheless the incidence of this complication may be minimized by performing a careful antiseptic toilet of the anal canal and perianal skin before the operation is commenced. All patients who have been subjected to hæmorrhoidectomy should remain in hospital for at least twelve days because of the possibility of this complication supervening.

In 1920 Gabriel[11] reported five cases of severe secondary hæmorrhage which had occurred in a series of 470 ligature operations performed at Saint Mark's Hospital. This was an incidence of a little more than 1%, a figure which has fallen to 0·5% since grossly infected piles were excluded from operation.

The most common time for secondary hæmorrhage is the eighth day. Some blood loss is noticed after difficulty with a bowel action, following which the patient slowly bleeds into the rectum. It is astonishing to see the large

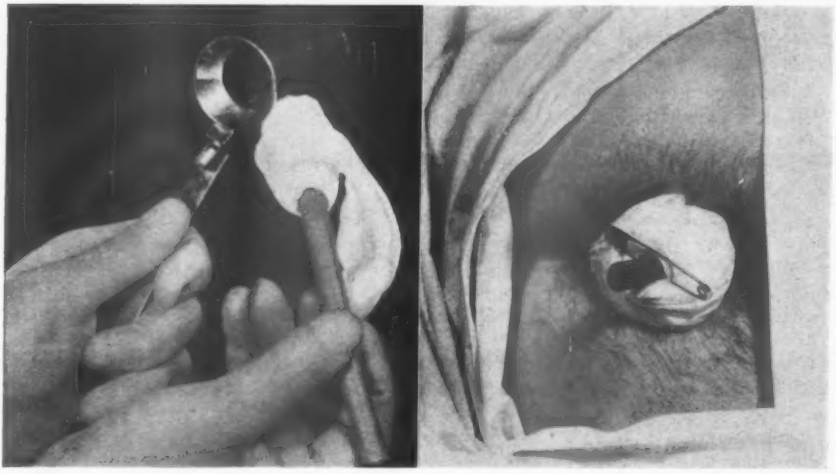


FIGURE IIA. FIGURE IIB.

Method of controlling hæmorrhage by plugging the rectum.

amount of blood which can accumulate in the rectum and colon with little or no external loss. Soon there are general signs of a serious concealed hæmorrhage—pallor, sweating and tachycardia—and the patient will call for a bed pan and pass a quantity of blood and dark clots. If immediate and decisive action is not taken the outcome may be fatal.

In treatment an injection of morphine, a quarter of a grain, is given, and arrangements are made for a blood transfusion to be available as soon as possible. An anæsthetic is desirable for the actual plugging, and for this purpose "Pentothal" is ideal. After a large proctoscope has been passed, clots are picked out with dissecting forceps and the rectum is irrigated with warm saline solution.

One end of a piece of rubber tubing six inches in length is bound around with dry ribbon gauze as shown in Figure IIA, and the outside of the gauze cylinder thus formed is smeared with "Vaseline". The necessity for a large proctoscope is obvious, since the size of the gauze mass which is to be inserted above the sphincters is limited by the diameter of this instrument. Such a speculum is one too large for ordinary diagnostic use. When the tubing and gauze have been passed into the rectum through the proctoscope, the instru-

ment is withdrawn over the tube. Gentle traction will now bring the lower end of the gauze plug against the ano-rectal ring where the bleeding vessel is usually situated. A large safety pin is inserted through the tubing just outside the anus, and ribbon gauze is then wound around the tube between the pin and the anus, as shown in Figure IIB. In this way pressure is exerted upon the bleeding area. I have found that there is an advantage in having the gauze which forms the outside roll continuous with that of the inside plug, this being easily achieved if one commences with a long length. At the time of removal some of the inside material may then be unwound and drawn out alongside the tube; this will prevent the trauma which is caused by the withdrawal of a large mass. The tube should be cut off just beyond the pin and a large pad of cotton wool held in position with a T-binder. The foot of the bed is raised, and the pulse rate recorded hourly. A blood transfusion should be given if serious bleeding has occurred.

Further trouble is not usually experienced after the rectum has been packed in this way. The tube and gauze are left in position for forty-eight hours, and the motions subsequently kept soft by liquid paraffin.

Stricture Formation in the Anal Canal.—This is sometimes referred to as "mucous" stricture, as distinct from skin stricture of the anal margin. No agreement has been reached concerning the frequency of occurrence of this complication, which depends on the type of operation performed as well as on the skill of the operator.

There is little doubt that Kilbourne's[1] figure of 0·22% is far too low. There are, of course, varying degrees of severity; but any patient into whose rectum the finger cannot easily be passed in the second week, or who during that procedure complains of more than slight to moderate pain, should be regarded as a potential sufferer from stricture formation. Close observation and regular passages of bougies are then required. Milligan states that in a series of 282 "stripping" operations an appreciable degree of stricture formation occurred in the upper anal canal in 32 instances (11·3%). In another series of 290 cases he states that there was an incidence of 9·3%.

The pathology of mucous stricture is a gradual contraction of granulation tissue in the submucous layer of the anal canal. This granulating area results from operations in which the piles are stripped up from the rectal wall in the submucous plane and then ligated at a high level, as shown in Figure IIIA.

Two factors now operate: (*a*) The upper third of the anal canal is narrow, especially where the pubo-rectalis exerts its important sphincteric action. Thus when the three ligatures separate in this region, a bare area results which is relatively large in relation to the circumference at this level. Lieberman[10] has advised that the three piles should be stripped up to different levels so that the resulting granulating areas should not form a circle. However, it is difficult to be sure that this is being done, and the result may be an incomplete removal of one or two of the hæmorrhoids. (*b*) The stripping in itself results in the formation of three long bare columns which granulate and subsequently fibrose.

In the operation devised by Milligan the dissection at no stage enters the submucous plane. By this means, and by the inclusion of the longitudinal muscle fibres in the ligature, the knot is kept at the very margin of the anus, immediately internal to the subcutaneous external sphincter (Figure IIIB). It may be noted that some who practise stripping operations suture the stump of the hæmorrhoid down to the anal margin, in an attempt to reduce the size of the bare columns. The fact that this operation should be thought to require such a modification is in itself an interesting commentary.

The treatment of submucous constriction ring is usually satisfactory. Its chief evil lies in the necessity for several additional weeks of hospitalization,

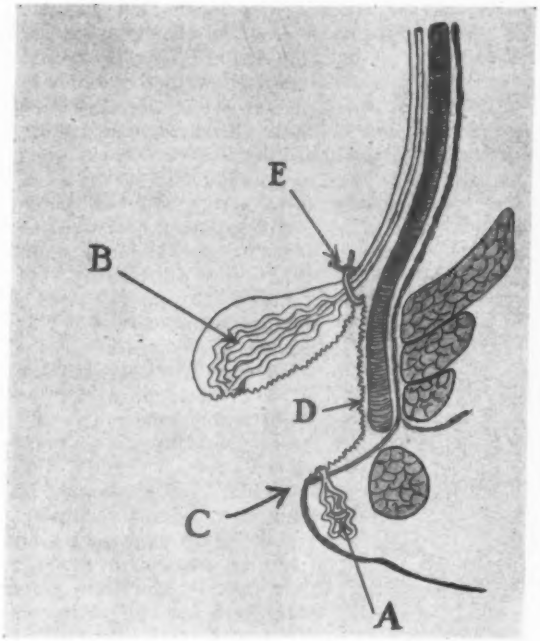


FIGURE IIIA. A stripping operation. A: external hæmorrhoid; B: internal hæmorrhoid; C: skin cut; D: raw area; E: ligature on stripped up hæmorrhoid.

the discomfort associated with bowel actions, and the pain of regular dilatations. In severe cases, however, and in milder cases when early treatment is neglected, a life-long disability may result. Such patients regard permanent difficulty in defæcation as a poor exchange for their piles.

Routine digital examinations should be performed on the seventh and fourteenth days after the operation of hæmorrhoidectomy. No tightness should be found and little pain caused by the gentle passing of a well lubricated finger. If stricture formation has not commenced by the fourteenth day, it will not appear later.

The most certain method of prevention of this complication is the abandonment of operations in which the incision is first made at the muco-cutaneous junction and the submucous layer there entered.

Skin Stricture.—So aware have operators been of the danger of anal skin stenosis following excessive removal of skin that this complication is rare. Rather is it a common practice to leave the external skin tags untouched. To the patient, however, these rather than the internal hæmorrhoids are his "piles". The blood return from the external hæmorrhoidal plexus, which underlies the skin tags, is not, as is sometimes stated, outwards into the ischio-rectal fossa, but upwards through the fibres of the

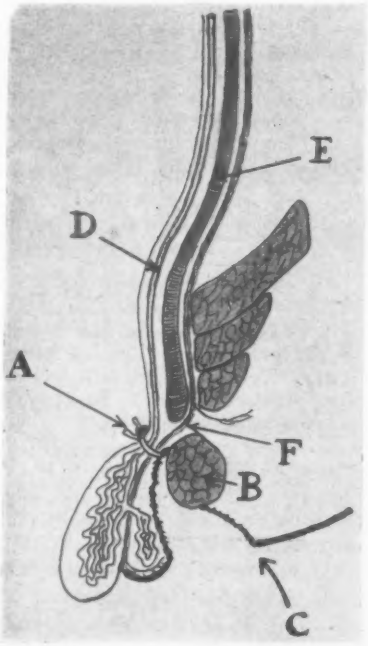


FIGURE IIIB. Milligan's operation. A: ligature on drawn down hæmorrhoid; B: subcutaneous external sphincter; C: skin cut; D: hæmorrhoidal vein; E: circular muscle; F: longitudinal muscle. Note absence of raw area.

longitudinal muscle into the veins of the internal hæmorrhoid. This is demonstrated by the swelling of the external skin area which results when the internal hæmorrhoids are drawn down prior to operation or are prolapsed and thrombosed. Thus, if the internal piles are excised and the external plexus is left, the skin tags undergo œdema and hypertrophy. A certain amount of shrinkage may occur over a period of some months, but the patient is often under the impression that his piles are still there. Although such a result is undesirable, it is indeed far preferable to skin stricture of the anus, a condition more serious than mucous stricture, and which dilatations will never cure.

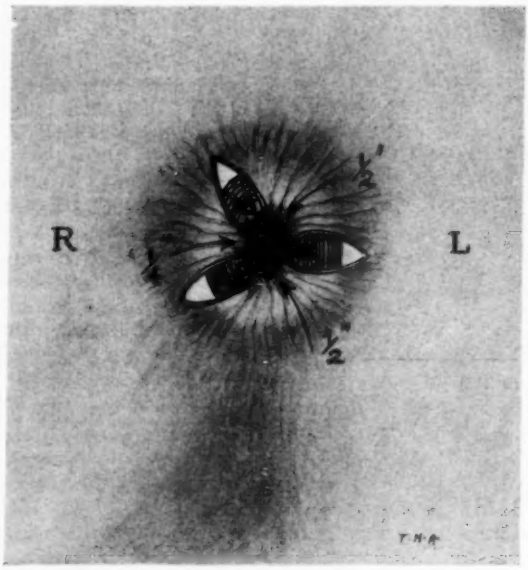


FIGURE IV. The minimum width for skin bridges in hæmorrhoidectomy.

Skin tags may be excised with complete safety if three intact skin bridges of adequate width are left. The minimum requirements for these is that each of the three shall be not less than one-quarter of an inch across. It is wiser, and usually possible, to arrange the skin cuts so that one quarter-inch and two half-inch bridges remain (Figure IV). On the right side, where two piles must be removed, special care is required.

When a posterior fissure *in ano* is also present, some interference with the posterior bridge is unavoidable. Figure V shows three alternative methods

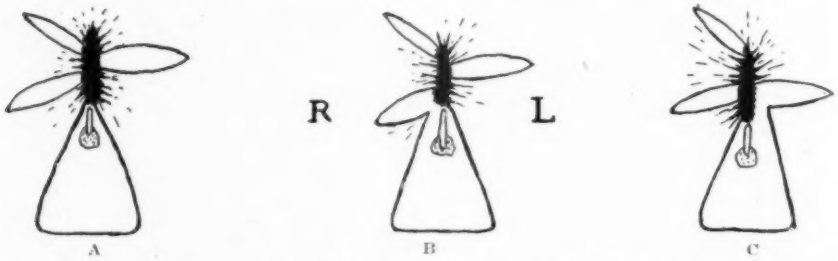


FIGURE V. Showing three methods of dealing with the combination of posterior fissure *in ano* and hæmorrhoids. Method A is preferable. Skin excision for the hæmorrhoids should be narrower than usual to compensate for the extra loss.

of dealing with this combination. If the left anterior and right lateral skin bridges are left slightly broader than usual in these cases, no skin tightness will follow.

Post-Operative Pain.—Some degree of discomfort is unavoidable for several days after hæmorrhoidectomy. The importance of a rubber tube in

making manifest what might otherwise be a serious concealed reactionary hæmorrhage, has already been mentioned. The tube must never be omitted in an attempt to minimize pain. Injections of morphine, one-quarter of a grain, are required during the first two days.

Some have advocated the injection of an oil-soluble anæsthetic at the time of operation as a means of combating post-operative pain. For very nervous and sensitive patients a posterior injection of 10 cubic centimetres of "Proctocaine" may be warranted, given before the patient returns to the ward. Routine use of this measure, as advocated by Ault,[15] appears to be unnecessary. Moreover, it must be remembered that it adds a small but definite risk of abscess formation.

Rowntree[16] believes that thorough stretching of the anal sphincters as a preliminary to operation lessens post-operative pain. This is by no means certain. Furthermore, mucosal tears are always caused by this procedure, and thus the likelihood of a tight anus is increased. The rough insertion of swabs on holders is another common cause of mucosal tearing and should be avoided. The anal canal should rather be gently cleansed with small swabs of cotton wool soaked in "Dettol" solution and wrapped about the right forefinger. Wool is softer and smoother than gauze, and is preferable for this purpose.

Retention of Urine.—Retention of urine is a complication which is especially liable to follow operations on the anal region. Reassurance and encouragement will usually succeed in persuading the patient to empty his bladder. The use of parasympathetic stimulants such as "Doryl" or "Esmodil" (one cubic centimetre administered subcutaneously) will often obviate the necessity for catheterization. The disadvantage of giving these drugs is that their action is not confined to the bladder. Unpleasant side effects such as sweating, salivation, nausea and the passage of flatus may also occur.

Abscess Formation.—Suppuration in one or other ischio-rectal fossa is an uncommon sequela. It may result from an imperfect aseptic technique when local anæsthesia is used, or when an oil-soluble anæsthetic agent is injected at the end of an operation. Smaller abscesses in relation to external hæmorrhoidal skin are occasionally seen, but should be rare if all tags are removed and the resulting wounds left flat and unsutured.

Portal Pyæmia.—In a survey of the literature of hæmorrhoidectomy I have been unable to find any reported cases of that dread complication portal pyæmia. It has been supposed to occur from the transfixion of a hæmorrhoidal vein, particularly when an operation is being performed on infected piles. There appears to be little doubt that this is a surgical myth.

UNSATISFACTORY RESULTS OF OPERATION.

External Hæmorrhoidal Tags.

The patient usually regards external hæmorrhoidal tags as his "piles", and hæmorrhoidectomy should include their removal. However, it is sometimes found that an anus which was smooth and neat after operation, may four or five days later show ugly œdematous tags. These will tend to subside during convalescence, but in part only, and some irregularity is likely to remain. It is therefore preferable to retrieve the situation on the seventh day, or thereabouts, by injecting a little local anæsthetic and excising redundant swollen skin. This is a routine practice at Saint Mark's Hospital, and is carried out without moving the patient from bed. Attention to the following points will minimize the occurrence of tags:

(*a*) A careful antiseptic toilet of the anal canal and perianal skin should be made before operation. The fact that complete surgical sterility is unlikely to be achieved sometimes causes neglect of this important step.

(*b*) The excision of loose anal skin at operation must be adequate. The upper limit of safety is indicated in Figure IV, and removal beyond this point is likely to produce skin stenosis. Undoubtedly fear of this has induced many operators to remove no skin at all, while at the other extreme inadequate skin removal results in unsightly tags.

(*c*) Enlarged external hæmorrhoidal veins should be filleted out from beneath the skin bridges which must be left. This is a most useful manœuvre, and may easily be performed by dissection with fine forceps and small sharp scissors, while the edge of the bridge is held up and everted by an assistant.

(*d*) Three gauze dressings should be slid into position between the tube and each skin bridge as the final step of the operation. This both stretches the skin and applies pressure to it, which helps in the prevention of œdema.

Recurrence of Hæmorrhoids.

Recurrence is more likely to occur when an operation has been performed on a young subject. The explanation may lie in any of a number of factors:

(*a*) At the time of operation two of the primary piles may be large, but the third may appear negligible. If this latter should be left, it is likely to increase in size and later cause symptoms.

(*b*) On other occasions small secondary or "daughter" piles may be overlooked at operation. These will subsequently enlarge. Care should therefore be taken in their removal, which may be accomplished either by drawing them across so that they are included in the ligatures of the primary piles, or by making separate corresponding skin cuts for them.

(*c*) Recurrence may simply be due to the fact that the whole of each primary hæmorrhoid has not been removed. Milligan teaches that the piles must be completely drawn down before their removal is commenced. When all three hæmorrhoids have been fully delivered, their pedicles will be seen to be connected to each other by folds of rectal mucosa. Milligan terms this appearance the "triangle of exposure".

(*d*) Lastly, one occasionally sees patients in whom the recurrence of varicosities in the anal canal appears to be inevitable in spite of a well performed operation. These resemble those cases of varicose veins of the lower extremities in which the process of vein formation is almost tumour-like in the progressive nature of its growth.

When bleeding recurs after hæmorrhoidectomy, the possibility of an associated condition should be considered. I have drawn attention to the difficulty which is caused when the rather rare condition of hæmorrhagic proctitis occurs in conjunction with hæmorrhoids.[17] Confusion may still occur when piles are absent. If in these cases oil injections are given in the belief that hæmorrhoids are the cause of the patient's symptoms, there will be no cessation of rectal bleeding. Lockhart-Mummery[18] refers to several patients upon whom even hæmorrhoidectomy had been performed without any relief of symptoms. The true diagnosis can be made if the interior of the rectum is carefully inspected. The patient is usually a young woman between the ages of twenty and thirty, and for a distance of three or four inches from the anus the rectal mucosa is seen to be uniformly dark red and spongy, oozing blood from numerous points. The condition is difficult to cure, but the hæmorrhage may be controlled by the application of solid silver nitrate to the mucous membrane.

More tragic are cases in which the real diagnosis is carcinoma of the rectum. The most careful digital and visual examinations, including sigmoidoscopy, should therefore be carried out before a patient is subjected to hæmorrhoidectomy.

SUMMARY AND CONCLUSIONS.

1. Even serious complications may follow both the injection and operative treatments of hæmorrhoids.

2. The causes of these are analysed. They are nearly always due to preventible errors in technique.

3. Unsatisfactory results, apart from complications, are not uncommon.

4. Operative treatment of hæmorrhoids should be a strictly anatomical procedure.

5. Hæmorrhoidectomy should always be preceded by sigmoidoscopy.

ACKNOWLEDGEMENTS.

I am indebted to Major-General S. R. Burston, Director-General of Medical Services, for permission to publish this paper, and to the Secretary and Librarian of the Royal Australasian College of Surgeons for their assistance in supplying books of reference.

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NEW TECHNIQUES AND OLD PRINCIPLES.[1]

By William Barclay Parsons,
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It is of course a rare privilege and distinction to be invited to address this assemblage, representative as it is of the best in Australasian surgery. It is also appreciated that the friendly gesture involved is not personal, but to the Medical Corps I have the honour to represent in my capacity as surgical consultant, and to the American College of Surgeons of which I am a Fellow. Therefore, representing these two organizations I bring you their fecilitations, their congratulations on the excellent work you have accomplished, their best wishes for greater success in the future and their feeling of confidence that you will continue to uphold the high standards of surgery in this continent and to serve the best interests of your fellow countrymen.

You are now in the fifth year of war, whereas we have barely started on our third year, so it would be presumptuous of me to deliver any sort of didactic lecture. It does seem appropriate, however, at this time to take stock, to view with a critical though kindly eye some of the new techniques, methods and agents and to remind ourselves once again of some of the fundamental basic principles that persist in war, as well as in peace-time, surgery. The literature of every period has its new thing, its "Golden Medical Discovery" as the patent medicine vendors were wont to describe their product, some of which proved to be in fact pure gold, but others merely tinkling brass. Brass has its peculiar value in certain circumstances, but not where gold is wanted, and the same holds true with a large number of the remedies and techniques that have been offered during the past decade or so. The easy way is always tempting, and the cure-all, whether a particular agent or method, is accepted enthusiastically in the hope that it will bring success without the need of thinking on our part. It is a mental process like the one termed "test-tubianism", which fortunately is less rife now than it was fifteen or twenty years ago, when all the new tests promised early, speedy and unfailingly accurate diagnosis.

War surgery is essentially simple surgery. It is so, perforce, because of the limitations imposed by combat conditions, urgency of evacuation, and the hazards and tribulations of transportation. The dramatic element of saving life appears relatively infrequently, whereas the process of wound healing and the problems incident thereto are ever present.

Neglect of the nature of, and the factors involved in, wound healing and violation of the fundamental principles of surgical technique, whether through ignorance, carelessness or conceit, never fail to threaten the successful healing of wounds. The fact that the threat is not always carried through to action indicates the marvellous *vis a tergo* of the reparative process, and emphasizes the point that in the care of wounds the surgeon must keep these principles constantly in mind and aim so to arrange the wound that the process may be helped and not hindered.

The one main adversary is infection. All procedures are based on this fact, even though life saving or other emergency needs attract immediate attention. In the forward area measures to prevent or to limit infection are adopted, whereas at the base control of infection becomes a major problem. In all areas one must observe the fundamental principles of cleanliness,

[1] Read at a meeting of the Royal Australasian College of Surgeons at Brisbane, December, 1943. Accepted for publication on February 25, 1944.

gentle accurate technique and real solicitude for the well being of the cell on the one hand and the man as a whole on the other. Shock, psychic strain, the local results of trauma, prevention of infection and preparation for either transportation to the rear or return to duty are the significant elements in the therapeutic problem in the forward area. At the base the therapeutic pattern consists of control of infection, restorative or plastic procedures, convalescence and rehabilitation. In both areas the threat of infection to life, limb or function is ever present. This fact has stimulated much work and thought in chemotherapy and various techniques. Interest and enthusiasm in these have tended to obscure basic principles of treatment for which various drugs, substances and techniques are merely adjuvants and not substitutes.

It was of real interest to read again recently the account of the inter-allied medical meeting held in Paris shortly after the Armistice under the auspices of the Research Society of the American Red Cross. The topics discussed then were identical with those we are so concerned with today, and with surprisingly few exceptions the conclusions reached then are applicable today. The main exceptions are dependent upon geographical differences between the concentrated theatre in France with its relatively good evacuation possibilities as compared to the jungle and island problems in the South-West Pacific, the frequent use then of Carrel-Dakin technique as compared with chemotherapy today, and our present greater knowledge of the mechanism of shock and ability to cope with it. Certain procedures were then in vogue because rapid evacuation was often possible to large hospitals for definitive treatment. In a very few instances new methods have been evolved recently, but the main difference lies in the attempts to achieve successful control of infection, and to combat shock. A few examples are well worth quoting from that and previous meetings, which, with the exception of the use of antiseptics, are as fundamental in 1943 as they were in 1918. Rules of guidance for operating teams were laid down which covered among other things:

(*a*) *Débridement* should be thorough. . . . Excise a minimum amount of skin. When possible avoid transverse incision of skin and muscle. Leave no tabs of tissue. . . . All high explosive and shell fragment wounds . . . must be freely opened. They should not be sutured, gauze lightly inserted. . . .

(*b*) All wounds of soft parts to be left open, except scalp and face: chest: abdomen —counter drain when necessary: joints—close capsule. Do not suture skin.

(*c*) The discussions on the dressing of wounds included the use of ether and iodine in the wound. In addition, twenty-three other antiseptics, including of course Dakin's solution, were discussed at length. Mosquito netting soaked in ambrine was recommended to avoid plugging the wound.

(*d*) Guillotine amputations were advised against in hospitals at the base. The opinion was three to one in favour of this type in forward areas.

(*e*) It was agreed that compound fractures should be approached through free incisions which should be left open. Loose pieces of bone must be removed. No wire or plates should be used for fixation. No drains must lie in contact with bone fragments. Both wounds of entry and exit should be excised widely enough to expose the bone involved.

(*f*) Surgeons must examine carefully before operation for loss of nerve function. Nerves should be sutured with fine silk and covered with fascia or muscle.

(*g*) The surgeon is responsible for the patient from the time he sees him, and must make his own decision as to the time selected for operation.

The study of the nature and treatment of shock received a strong impetus during the last war. At this meeting men like Cannon, Crile, Wallace, Professor Barcroft, Castellani, Bowlby, Middleton and others discussed blood transfusion, intravenous use of saline solution with and without gum acacia, and the use of heat. They were thinking along the lines of fluid balance, later to receive so much attention, but were bothered and uncertain over techniques of administration and methods of preparation of the various

solutions then in use, and above all by apparent discrepancies in the results obtained. Much research in the ensuing twenty-five years has provided the answer to many of the questions so frequently discussed at that time, and also has made the use of blood and blood substitutes an everyday matter in which we rightly place such implicit confidence. One cannot help wondering, when one considers the calibre of those men so preeminent in the medical schools, laboratories and hospitals of their day and yet so unaware of the underlying physiology of shock, what blind blundering we may be doing today in utter ignorance of other fundamental facts. We can hope that the next generation will be as charitable in their judgement of us as we feel toward our teachers and great figures of the last generation.

It is perhaps a slight digression from the main theme, but there are certain principles of organization that may be worth consideration in that they may affect the application of treatment. The function of the medical corps is twofold: to keep as many men as possible on a full duty status and to give all sick and wounded the best possible care. The function of the more advanced units is mainly that of caring for patients due for evacuation to the rear, as but few will be returnable to duty from these units. At some echelon the possibility of adequate care of the lightly wounded will appear, as well as treatment of those with the milder illnesses and psychiatric conditions, most of whom will be returnable to duty after a short hospital stay. This principle was recognized late in the last war, and although the application of it was limited, it was extensive enough to prove its importance. From the humanitarian point of view we must do every last thing possible for the severely wounded man. We must remember, however, that it will be a long time, if ever, before he will be of any military value to the army, whereas the saving of man-days of active combat duty by early thorough care of the lightly wounded is of the greatest military importance. The results of such treatment will be in direct proportion to the interval between the receipt of a wound and operation, and to the degree of professional skill afforded. Delay in the treatment of a trivial wound may result in the development of infection or in the production of a condition in which less than ideal surgery is all that can be done because of fear of infection. The wound that early had been easily handled and would have required ten days or so for healing to be completed, becomes through delay infected or changes into a sluggish, granulating affair that may require weeks of hospitalization. During this period the man himself gets soft physically and temperamentally and will need a long period of reconditioning before he is fit for combat duty.

The establishment of triage, namely sorting and distributing, is an essential feature in the organization of any line of evacuation, but particularly where a large number of sick and wounded must be handled in a short period of time. Good triage reduces multiple handling of patients, saving both time and labour, and leads to a smoother operation of the admitting system and therefore to better treatment of the sick and wounded. However, triage is futile unless the units receiving patients are well organized for the proper segregation of different types of casualties—for example, surgical emergencies, lightly wounded, patients with malaria, with mild psychoneuroses and so forth. Both triage and segregation are essential in times of great activity, whereas in slack times almost any admitting system can function adequately. It is not unreasonable to expect that the group of slight severity will certainly be a sizeable percentage of all the sick and wounded, perhaps even as high as 50% of the total. If this group could be hospitalized early in the line of evacuation a large part of the load on the transportation system in both directions would be lifted and the burden on the hospitals considerably lightened, in that the length of stay in hospital

would be shortened for a large number of patients and all the admitting and discharging and reduplication of record-keeping in several hospitals would be done away with. Transportation would be liberated for other purposes, staffs of the hospitals in the rear could devote themselves to the care of the more serious casualties and a large number of soldiers would be returned earlier to duty instead of getting back to a base or even to the mainland with all the loss of time thus entailed.

The intravenous administration of blood substitutes has fulfilled all that was claimed for it as the best available method for treating shock. Whole blood is required occasionally when there has been a marked loss of blood, but plasma or serum suffices for the vast majority of cases in shock from wounds or burns. A single flask administered in the battalion aid station immediately after the receipt of a wound may be the deciding factor in preserving life in that it may allow transportation to an operating table of the casualty who without it would have died, and frequently is of more value than two or more flasks given a few hours later. The reason for this is that the process of shock is reversible in severe cases for only a certain interval of time, and the earlier treatment is started, the easier it is to reverse the process. After this interval the process becomes irreversible and even large amounts are ineffectual. In this matter, as was mentioned previously, the responsibility is on the shoulders of the surgeon and should not be shifted to members of the shock team regardless of their experience. He should be the one to determine the condition of his patients and when the optimum time for operation has arrived.

The human mind is a strange thing. With all the literature on the subject it is so interesting that the same mistakes should have been made in the treatment of wounds in the forward areas or so many theatres and even so recently. Reference is made to suturing of wounds, to tight packing, and to imperfect *débridement* where thorough work was indicated. Such errors result in the infection of sutured amputation stumps, burrowing infection in muscle planes, osteomyelitis and gas infection. In ten out of thirteen cases of gas gangrene recently reported, one or all of these sins had been committed. In all of these it is probable that too unthinking confidence was placed in one of the sulphonamides, with neglect of the fact that proper surgery alone will accomplish much, and that all the sulphonamides in the world without proper surgery will do nothing in any of the serious cases. Sulphanilamide used locally, as part of the first aid treatment to a contaminated wound, in that it inhibits the growth of bacteria, seems to prolong the period prior to the development of infection, thus allowing for later successful *débridement*. Considerable evidence is accumulating that after operation the local application is of far less value than the systemic administration, and some go so far as to say that it is completely without value, partly because the action of sulphanilamide is inhibited in the presence of pus. Definitive treatment is designed to leave a wound bounded by healthy living tissue and containing only minimal contamination. When free drainage is afforded, healthy tissue can master contamination in the vast majority of cases. The insertion locally of any of the sulphonamides, even when care is observed as to the amount used, may result in the formation of cakes or lumps which act as foreign bodies and delay repair. Experimentally they have been found to interfere with cellular repair and particularly in burns are of more harm than good. One sees many wounds that are dusted as part of a sort of dressing ritual which day after day show the same glazed appearance without any obvious reduction in size. On the other hand, oral or systemic administration has without much question been of the greatest importance in cutting down the severity of infection. Perhaps the sulphonamides given

by mouth have also been of value in reducing the severity of anaerobic infections, in that by control of the pus-producers there has been an indirect vicarious control of the gas-producers, although they are inactive directly against anaerobes. The latter require dead tissue for their growth. Adequate *débridement,* free drainage and the control of the pus-producers will reduce to a minimum the amount of dead tissue for the anaerobes to grow upon. It is too early to say more about penicillin than that the reports emanating from England and the United States promise great things for this agent against the cocci and perhaps against the anaerobes. We can hope that the reports will prove to have been conservative, as further knowledge and experience are gained with what promises to be a real life saver. Regardless of how good it may prove to be, it will remain only an adjuvant to and not a substitute for good surgery.

Let us review briefly the three common causes of the errors noted above, and investigate the principles involved. *Débridement* is merely part of the process of preparing a wound for the stage of repair by producing in it as nearly as possible the conditions existing in a clean incised wound. Cleaning the skin around a wound is almost as important as debriding its contents as far as prevention of secondary infection is concerned. *Débridement* involves the systematic careful removal of dead tissue, of foreign bodies and of any damaged tissue that cannot be expected to survive. In general, as little tissue as possible should be removed. This applies particularly to skin, of which but the smallest amount should be cut away. Muscle contused so badly that it has lost its colour, contractility and ability to bleed should be sacrificed. Any bone fragment still attached to soft parts should be left *in situ*. An undivided nerve should be scrupulously protected, but in order to maintain their length, divided nerves should be approximated if only with one or two fine stitches of silk or cotton, or attached to nearby structures and covered with muscle or fascia. When peripheral nerves are wounded it is of the utmost importance to make a careful neurological examination and to record diagrammatically all sensory and motor loss. This is of great value to the next hospital in line, and is particularly true when the limb must be encased in plaster. Experience shows that the layer to be sacrificed in most wounds is thinner than at first expected. Clothing, gross dirt and large loose fragments of bone are far more important as foreign bodies than small particles of metal. The size of a metallic foreign body is an important factor in the disturbance that it will cause in the tissues, and if it is to cause a septic reaction it will do so in a very few days. This fact permits the surgeon to neglect many large pieces of metal until a convenient time for removal has arrived, and applies to all parts of the body, in particular to the lung and the brain. Any suspicion that gas infection is present or likely to develop indicates a wide excision, the laying open of neighbouring fascial planes and compartments, and the sacrifice of any tissue that may interfere with free drainage by contributing to the building up of tension. Wounds of large muscle bundles, particularly the buttocks, of the abdomen, and serious compound fractures, particularly those with interference to the blood supply, represent the group of wounds in which gas infection is apt to develop. One can achieve only rarely the ideal of producing a clean incised wound, but one can produce a wound with minimal contamination and provide ready drainage. It is evident therefore that primary closure of wounds predisposes to infection and must be avoided. In civil practice operating theatre conditions are better than in forward units and, what is vitally important, the patient will not require evacuation prior to healing. The jolting incident to transportation causes shifting of tissue planes and the production of dead spaces filled with blood or serous exudate in which infection proceeds readily.

There are only three exceptions to the no primary suture rule. All sucking wounds of the chest must be promptly closed and often without any attempt at *débridement*, at least the muscular wall, if not the skin, of abdominal wounds must be closed after operation, and most head wounds do better with closure around a drain as infection in the scalp is not as common as elsewhere.

Unfortunately the word packing, as it appears in the literature in the description of the methods used in wound dressings, has been misinterpreted to mean tight packing. Plain or preferably "Vaseline" gauze should be merely placed loosely into a wound and never "packed in". Drainage will occur around and through such loosely placed gauze and the wound itself can collapse partially. Granulation tissue will grow into the meshes of coarse gauze and will be torn and bleed at subsequent dressings. To avoid this, fine mesh gauze such as the 44 mesh used in bandages is the desirable material for use in wounds and on burns. Thus the two sins of commission, suturing and packing, and the one of omission, imperfect *débridement*, are due to one or more of the following faults: an inability to resist the temptation to do too much, a reluctance to do enough, a disregard of fundamental surgical principles such as cleanliness, solicitude for the tissues and those things that effect repair, and lastly undue reliance on bacteriostatic agents.

Without going into details of treatment, there are certain main classes of wounds in which the observance of those underlying principles of wound healing and avoidance of those practices liable to interfere therewith are so important. Statistics are significant to a degree, but in any individual case are helpful only in so far as quoting betting odds are concerned. We never want to adopt a routine course of treatment knowing it will fail in some instances. Instead we should consider the particular problem and how it can be solved by the application of accepted principles, rather than by what is the fashion of the day, regardless of how successful the latter may be in certain cases.

Compound fractures represent a large percentage of battle casualties. In those units forward of that hospital where permanent care will be given, these cases will require principally three things: (*a*) treatment of shock, (*b*) care of the soft-part wound, and (*c*) immobilization for transportation. Attention to length and alignment is desirable, but not to be sought for in forward units, if so doing jeopardizes any of the three main requirements, or prolongs the time of operation, or increases manipulations, all of which predispose to infection. In cases with comminution a delay of a fortnight more or less prior to admission to a hospital for definitive treatment is not usually long enough to prevent the obtaining of good length and alignment. Shock is the rule in all major fractures and should be combated at the earliest possible moment with plasma, morphine and immobilization. Operative care of the soft-part wound is to prevent infection and to furnish healthy living tissue in contact with the bone fragments. The primary stage of bone repair depends on the surrounding tissue rather than on the bone tissue at the line of fracture, which points to the importance of skill and care in the *débridement* of these wounds, the observance of measures to obviate infection, and the immobilization and protection of the part to prevent further damage and the elimination of dead spaces. The care of the soft-part wound and of the bone wound must be carried along simultaneously, with no slighting of one in favour of the other, except as the need for transportation may alter conditions temporarily. Let it be perfectly clear, however, that accurate apposition of bone to bone is essential for healing of the fracture, and that undue delay in this respect is costly in the matter of time and of end result. The previous statements were merely to call attention to the point that for a few days length and alignment are relatively less important than the other

factors mentioned, particularly in cases with severe comminution, but that as soon as the patient has arrived at a hospital where he may be given well controlled definitive care the bone wound assumes equal importance with that of the soft parts.

First aid treatment includes dusting with sulphanilamide and the application of a protective dressing, it being assumed that morphine, tetanus toxoid and plasma are given when needed. Oral administration of sulphathiazole or sulphadiazene should be started as soon as convenient and, of course, continued until all danger of infection is passed. The first definitive treatment begins with thorough cleansing of the surrounding skin, while the depths of the wounds are protected by the original dressing or a gauze pack. This is followed by brief irrigation of the wound and thorough *débridement* of the soft parts with minimal removal of bone. Both wounds of entry and exit should receive attention as the fascia and muscle on one side are as apt to cause tension and infection as on the other. If one has the courage of his convictions he will use or omit the local application of one of the sulphonamides as he sees fit. Fine mesh gauze impregnated with "Vaseline" should then be placed loosely into the wound in just sufficient quantity to insure good drainage from the very depths and to prevent the formation of dead spaces. Nice reduction without the employment of internal fixation should be sought for whenever possible, but this is often impossible owing to extensive comminution and loss of substance. Immobilization for transportation, the third main requirement, must then be provided. The Thomas splint, while excellent for application at the battalion aid station, is not good for long trips. The particular type of plaster cast used is of slight importance provided that the cast is comfortable, does not cause constriction or local necrosis, and successfully immobilizes the limb. To avoid the needless and often harmful frequent changing of casts, some note should accompany the patient indicating any anticipated or feared complication, or if, on the other hand, the cast may be left undisturbed with confidence. There has been much discussion as to the length of time which should elapse before the first cast is changed in cases of fracture, and also when one has been applied to a soft-part wound. Too early and frequent changing of casts causes damage to cells in the first stages of repair and increases the chance of secondary infection. If a wound has been properly cared for, if the man has been taking sulphonamide, preferably sulphadiazene, and if he is comfortable and not showing any clinical evidence of infection, there is no need for changing the cast for some weeks. It may be wise, however, to change most casts at the end of ten to fourteen days for certain definite reasons. At this period in wound healing the granulations are well established, some small pockets that would be better cleared up at this time may be present, the early copious discharge will have altered in kind and amount, and lastly the fracture may want improvement in position. At this stage it is usually possible to mould the fragments into better position, and a review of the wound followed by reencasement for another period of several weeks will avoid many of the disagreeable features of the "closed method". As Orr points out, the "closed method" is really an open method in respect to the wound itself, the cast merely enclosing the whole limb including the wound. Success depends on adequate excision, on adequate opening up of tissue planes by removal of obstructing or harmful material, and on adequate immobilization in plaster, the last combining physiological rest, supportive tissue pressure, and protection from frequent dressings. That gas infection, in the experience of Trueta, was rare when proper attention to the wound had been furnished, was unquestionably due to the fact that remaining

necrotic material was minimal, and that drainage and exposure of viable tissue to the air were maximal.

The treatment of burns has recently been pretty well stabilized along conservative lines, all tanning methods having been proven unsatisfactory. The minimum amount of cleaning is indicated without any attempt to remove blisters or superficially destroyed skin. Local use of any of the sulphonamide drugs is to be deprecated, in that they interfere with cellular repair and are often associated with too great absorption of the drug. Sulphadiazene systemically in full dosage should be started immediately and continued for at least a week in all cases in which a third degree burn may be present. This is far more efficacious than by topical application and avoids the danger of toxicity, as the dosage can be accurately controlled. The ideal dressing is "Vaseline" on fine mesh gauze laid gently on the burnt area and covered with a few layers of gauze covered with a voluminous layer of mechanic's waste or cotton, the whole covered with a firm pressure bandage or stockinet. The charred cells are ash, and as such may be disregarded. The damaged cells, in addition to prompt protection of the least irritating sort possible, want measures to support their nutrition. Treatment of shock improves the general nutritive state of the man as a whole; the local pressure, by preventing œdema, aids the nutrition of the cell. These dressings should be left undisturbed for ten to twelve days, at which time most sloughs will have separated. Treatment of the associated shock may require very large quantities of plasma, perhaps as much as 3,000 cubic centimetres in the first twenty-four hours, on the basis of 500 cubic centimetres for each 10% of the body surface burned. The Berkow method of estimation of body surface assigns 6% of the body surface to the head, 18% to both upper extremities, 38% to the trunk and 38% to both lower extremities, the legs and feet being roughly equal in area to the thighs. In burns saline solution should be used with the greatest care on account of the danger of salt retention, any œdema already present being thus increased. Glucose solution, up to 200 grammes of glucose daily, may be needed to preserve hepatic glycogen. In early jaundice and anuria 300 grammes of glucose (6,000 cubic centimetres of 5% solution) may be needed in addition to large amounts of plasma, but once this stage has been reached the process is seldom reversible. It is interesting to observe that the repair of burns is, if anything, hindered by prolonged washing and that infection in compound fractures is also more likely with maximal rather than minimal washing. This is presumably due to further damage to the cells in the floor of the burn or wound. This damage is by drying and the washing out of substances important to the life of the cell.

Severe suppurative infection is rare in cases properly treated, but will appear occasionally, particularly when the wounded man cannot be brought in for early treatment, and must be dealt with courageously and radically. Drainage must be provided to all parts of the wound. Gas infection is of course greatly to be feared, but proper care of wounds usually will prevent its appearance. Even small apparently unimportant wounds through large muscle bundles should be laid wide open and the dense overlying fascia incised to make certain that there has been no marked damaged to the muscle substance. When this has occurred the fascia should be divided across its fibres and the damaged muscle excised. This applies to the wound of exit as well as to the one of entry, both of which should be left wide open, and if there is any suspicion of gas infection being present antiserum as well as penicillin when available should be given. Clear-cut cases of gas gangrene are of course easily diagnosed and must be radically treated. Gas infection should be suspected when a patient continues in the state of shock, with pallor, rapid pulse, sweating, elevation of temperature, pain or sense of

heaviness in the part and the alertness so common in this infection. Slight bronzing of the skin, the characteristic odour which is less sweet in the œdematiens cases than in the other types, a thin brownish discharge, a brick red tint to the muscle substance with loss of contractibility and the power to bleed are several of the important diagnostic points prior to actual gas formation. It is earnestly hoped that penicillin in these cases and in the severe suppurations will prove efficacious.

In conclusion let us again note that in traumatic surgery one is dealing with a contaminated wound. Operative interference is designed to leave only healthy living tissue forming the walls of the new wound with minimal contamination within it. The repair process in all wounds entails the same processes that are required to heal a simple clean incised wound, regardless of the tissues or organs involved. The superimposition of infection and the involvement of different kinds of tissue will complicate the process, but will not change any of the fundamental steps or stages. The surgeon must keep the principles involved in mind, basing his procedure on them, but using appropriately modern chemotherapy and other agents as adjuvants, but not as substitutes for sound surgery.

TRAUMATIC LESIONS OF LARGE BLOOD VESSELS TREATED IN A PRISON CAMP IN GERMANY.[1]

By BROOKE MOORE,
Major, Australian Army Medical Corps, Australian Imperial Force.

THIS paper consists of the report on thirteen cases of traumatic lesions of large blood vessels seen at the Number 1 *Kriegsgefangenen Lazarette* (Number 5 Australian General Hospital), Pyreus, Greece, in 1941, with some observations on the cases.

The patients all came into hospital many days after the initial injury. There were two cases of brachial arterial injury, one with associated nerve lesions; one case of axillary arterial injury, and one with associated nerve lesions; four cases of popliteal arterial injury, two with associated nerve lesions; six cases of femoral arterial injury, one with associated nerve lesions.

Two patients with femoral lesions came in with pulsating swellings noticed on admission. The other patients became recognized as having vascular lesions at various times from three days to six weeks, the average being probably two to three weeks, or three to four weeks after the injury.

The reason for the delay appears to be due to the nature of the injury rather than to failure to look. In most of the patients who came to operation the artery appeared to have been partially torn. A hæmatoma of varying size formed, causing the region of the injury to become swollen and hard.

Later either (*a*) the hæmatoma ruptured into a fascial plane causing a large internal hæmorrhage, or (*b*) it became partly absorbed, allowing the tissues to shrink and make the pulsating swelling evident, or (*c*) when the arterial wall was only weakened, in time an aneurysm developed slowly.

The number of cases, thirteen among about 3,000 total admissions, nearly all suffering from surgical conditions, may have been exceeded by a few missed cases, as after a while the medical officers in charge became more alert to the possibility of these cases. However, Professor Pfeiffer, a German consultant surgeon, who saw most of these patients and gave advice, said he had never seen so many before.

SIGNS AND SYMPTOMS.

A lump was present in twelve cases. A thrill was present in twelve cases. A bruit was present in twelve cases.

The blood pressure was measured distal to the lesions in six cases, and on being compared with the pressure in the sound limb was found to be less by amounts varying from 0 to 60 millimetres of mercury. Small missiles caused all the lesions.

Nine patients came to operation with one death. In this instance death was due to sepsis and gangrene of the leg and thigh in a high femoral aneurysm with fracture of the femur in the region of the great trochanter.

The indications for operation were increase of swelling or pain.

TYPES OF OPERATION.

1. In three cases of high femoral aneurysm the external iliac artery and vein were ligated, and then a direct attack was made on the lump, the tear

[1] This paper was received from a prison camp in Germany, bearing the date July 26, 1943, and having been forwarded through the International Red Cross Society, Geneva, Switzerland. It was accepted for publication on February 23, 1944.

being found and artery and vein ligated above and below this. The three cases were numbers 4, 8 and 9. No operation was performed in Case 12.

2. In two cases lower down the common femoral vessels were ligated above, and through a downward extension of the same incision a direct attack was made on the lesions (Cases 3 and 10).

3. In two cases of popliteal aneurysm the artery and vein were tied above and below (Cases 5 and 7).

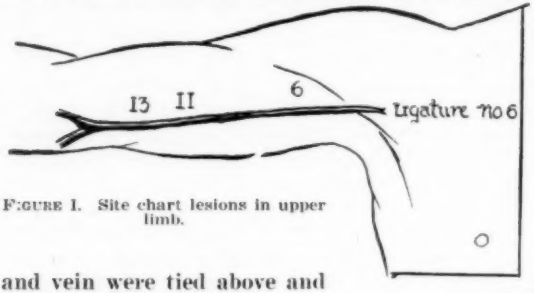

FIGURE I. Site chart lesions in upper limb.

4. In one case of popliteal aneurysm after ligation of the artery and vein above, the clot was turned out and the wound packed (Case 2). In one high popliteal lesion no operation was performed (Case 1).

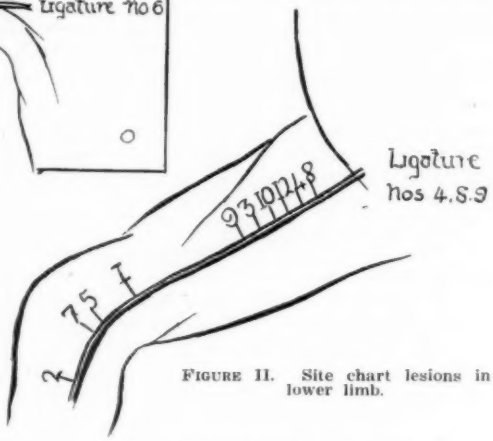

FIGURE II. Site chart lesions in lower limb.

5. In one case of axillary arterial injury the sac burst in hospital internally, causing a huge hæmatoma of the arm and forearm. The first part of the axillary artery and vein were ligated after the pectoral muscles were cut, the artery was ligated again above and below the lesion in the third part, and the clot was turned out (Case 6). There were extensive partial nerve lesions in this case which were slowly clearing up when the man was last seen.

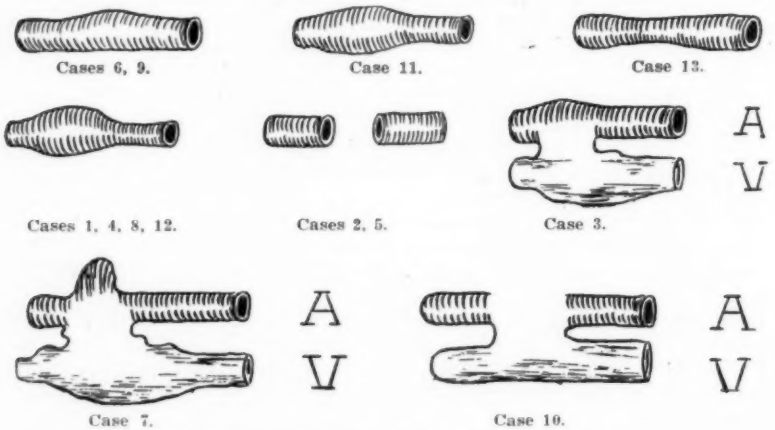

FIGURE III. Diagram showing types of lesion in the several cases.

6. In two cases of brachial arterial lesions no operation was performed (Cases 11 and 13).

GENERAL REMARKS.

All the wounds for ligation of the external iliac vessels healed by first intention. All the wounds for approach to the lesions suppurated and several secondary hæmorrhages which required packing, occurred, although gross sepsis was not obvious before operation.

Owing to the sepsis risk and to the matted adhesions invariably present at the site of the lesions, complete removal of the injured segment of artery was impracticable, as were the opening of the sac and the tying of the branches from within.

In all cases it was found that the incision had to be larger, the hæmorrhage was more alarming and the operation more difficult than was expected. A satisfactory tourniquet was not always available.

It would seem wise, therefore: (i) to consider the possibility of the occurrence of these lesions in most wounds, and to keep looking for them; (ii) to avoid operation as long as possible, to allow sepsis to abate.

In one case pulsation had returned to the popliteal artery before the patient left hospital.

Most of the operations were performed by myself, the rest by Major Harvey, R.A.M.C.

I regret that owing to service difficulties no greater detail of the cases is available. The proportion of right and left lesions is not shown on the site charts.

SUMMARY.

A report is given of thirteen cases of traumatic injury to large blood vessels of the extremities, with some notes on the surgical treatment of early cases, indications and difficulties.

ACETYLCHOLINE SYNTHESIS AND MYASTHENIA GRAVIS.[1]

By E. R. Trethewie and R. D. Wright,
From the Department of Physiology, University of Melbourne.

Introduction.

Torda and Wolff[(1)] (1943) have shown that plasma from patients with *myasthenia gravis* allows less synthesis of acetylcholine than does that of normal patients. Removal of the thymus frequently ameliorates the state of those patients. We therefore investigated the effect of thymic extract on the synthesis of acetylcholine.

Method.

Brain was ground up and incubated as described in an earlier report (Trethewie,[(2)] 1938) except that glucose was added to all samples to make it 0·02 M, oxygen was always used, and the eserine concentration was 1 : 300,000, the pH being 7·4. Thymus was obtained freshly at operation and placed in the ice chest two hours later, or from infants dying at birth, and was ground up with silica in glucose-free tyrode and added to the brain samples by volume. The infants were placed in the refrigerator at death and the thymus was removed eighteen hours later in the one instance (Experiment 3) and 100 hours later in the other (Experiment 2).

Result.

The findings are recorded in Table I.

In a control experiment in which no thymus was added the synthesis in one sample was 2·0γ and in the other 2·1γ acetylcholine per gramme of brain. When thymus from infants dying at birth, but in which no disease

Table I.

Change in Acetylcholine Synthesis.

Experiment.	Subject.	Synthesis per Gramme of Brain. (Control.)	Synthesis per Gramme of Brain. (With Thymus.)	Weight of Thymus Added (per Gramme of Brain).	Increased Synthesis.
1	——	2·0γ	2·1γ	Nil	+0·1γ
2	Infant.	1·2γ	1·9γ	0·1 gm.	+0·7γ
3	Infant.	4·0γ	4·4γ	0·7 gm.	+0·4γ
4	*"Myasthenia gravis."*	1·3γ	0·9γ	0·2 gm.	−0·4γ

process was detected, was added to the samples, an increase in synthesis was detected. In Experiment 2 thymus was obtained from an infant which had died of asphyxia, and in Experiment 3 from an infant prematurely delivered by the breech which died soon after birth. The increase in synthesis was 0·7γ and 0·4γ acetylcholine per gramme of brain respectively. It is to be noted that Torda and Wolff (1943) have shown that human serum, when added to frog brain, increases the synthesis of acetylcholine in the presence of glucose and oxygen.

[1] Accepted for publication on March 6, 1944.

When thymus from a patient suffering from severe *myasthenia gravis* was added to brain, glucose and oxygen, there was a decrease in the amount of synthesis. This is recorded in Table I, Experiment 4. Without added thymus the synthesis was 1·3γ acetylcholine per gramme of brain, while with added thymus it was only 0·9γ per gramme. This patient frequently required 12·5 milligrammes of prostigmin per day by injection to control her muscular weakness. Torda and Wolff (1943) showed that serum from patients with *myasthenia gravis* when added to brain yielded a much smaller synthesis of acetylcholine than did normal serum. The average increased synthesis with "normal" thymus was 1·1γ in 5·2γ, or 21%, while the decreased synthesis with "myasthenia" thymus was 31%. The acetylcholine activity of this thymus was 0·21γ per gramme and in the dilution used would have no effect on the estimation of the brain sample. The findings in Experiments 3 and 4 are shown in Figure I. In the upper panel it is seen that comparing dilutions of 1/80 (1 gramme of brain to 80 cubic centimetres) there was an increase in the acetylcholine content following incubation with glucose and oxygen (A) over that initially present (C) and there was a further increase (B) in the sample to which infant thymus was added. In the lower left hand panel the response at C is to 1 in 80 of control unincubated brain (Experiment 4). The response

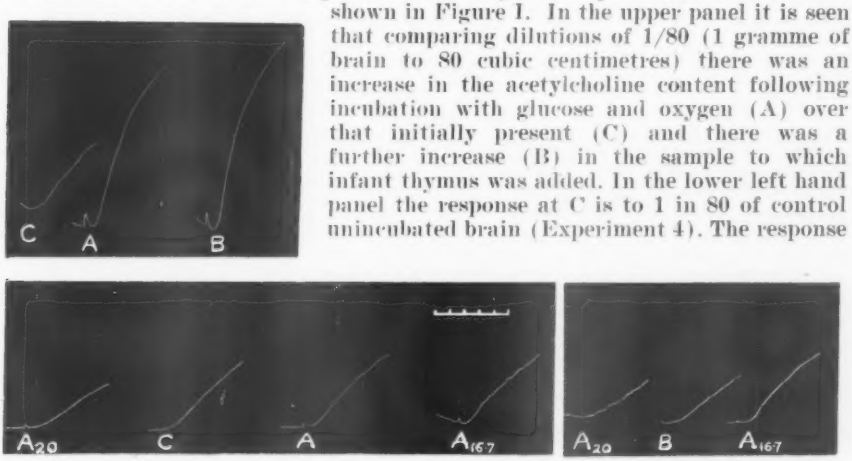

FIGURE I. Upper panel (Experiment 3): Response of frog rectus to brain extracts, all diluted 1/80. Response at C to extract boiled immediately; at A to extract incubated two hours and boiled; at B to extract to which "normal" thymus was added, incubated for two hours and then boiled. Lower panel (Experiment 4): Responses of two recti to brain extracts. At C response to 1/80 brain extract boiled immediately; at A response to brain extract incubated two hours, then boiled, diluted 1/100; at B response to brain extract to which "myasthenia" thymus was added, incubated for two hours and then boiled, diluted 1/100; at A_{20}, $A_{16·7}$ responses to acetylcholine 1 : 20 and 1 : 16·7 millions. Time in minutes.

at A is to 1 in 100 of incubated brain without added thymus. It is seen to be equal to acetylcholine 1 in 16·7 millions ($A_{16·7}$). In the right hand panel (responses from another rectus) it is seen that 1 in 100 incubated brain to which "myasthenia" thymus was added (C) gives a response little greater than 1 in 20 millions acetylcholine (A_{20}) following incubation.

DISCUSSION.

Though only one case is recorded, both the infrequency of obtaining the thymus in a fresh state from patients suffering from *myasthenia gravis* and the parallelism between these findings for the thymus and those of Torda and Wolff[10] (1943) for serum indicate that it is worth while to record these findings.

Torda and Wolff suggest that there are only three likely explanations of the deficiency in *myasthenia gravis*, and exclude the first—namely, excess destruction of acetylcholine by esterase. It is to be noted that Odom, Russel and McEachern[11] (1943) have also shown that there is no increase in the

amount of esterase in the blood of "myasthenia" patients. The other two possibilities are defective utilization of acetylcholine and defective synthesis of acetylcholine. Torda and Wolff have brought forward evidence for the latter possibility. We have extended this investigation and present some evidence in support of the rationale for the removal of the thymus in *myasthenia gravis*.

Since there is an increasing weakness on exertion, it seems, from the clinical aspect, that the condition of the patient is not necessarily due to an initial diminution of acetylcholine, but that return to the condition prior to exertion does not take place. It is to be noted that more than the initial content of acetylcholine can be liberated from the cervical ganglion following stimulation of the preganglionic fibres, and fatigue with depleted depots is thus guarded against. With *myasthenia gravis*, however, the deficiency appears to result from inability to refill the depot so that after exertion the condition is worse than before. This seems to be in agreement with the experiments both of Torda and Wolff and those recorded here.

SUMMARY.

1. An increase in acetylcholine synthesis was detected when "normal" thymus was added to brain extracts.

2. A decrease in acetylcholine synthesis was observed when thymus from a severe case of *myasthenia gravis* was added to brain extract.

3. The significance of these findings is discussed.

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(2) E. R. Trethewie: "Synthesis of Acetylcholine by Brain Tissue", *The Australian Journal of Experimental Biology and Medical Science*, Volume xvi, 1938, page 343.

(3) G. Odom, C. K. Russel and D. McEachern: "Studies of Neuromuscular Disorders: Myogram, Blood Cholinesterase, and Effect of Prostigmine in Myasthenia Gravis and Progressive Muscular Atrophy", *Brain*, Volume lxvi, March, 1943, page 1.

PHYSIOTHERAPY IN CHEST SURGERY.[1]

By JOHN I. HAYWARD,
Major, Australian Army Medical Corps.

THE following paper is intended primarily for the guidance of surgeons and physiotherapists treating surgical conditions of the chest in this war. It is based on the methods evolved during the past twenty years largely at the Brompton Hospital under the guidance of Mr. J. E. H. Roberts. As far as I am aware, no previous paper describing the exercises in detail has appeared in a surgical journal. No amount of description can wholly replace practical demonstrations, and those interested are advised to avail themselves of any opportunity of seeing the work of a physiotherapist trained in modern chest exercises. Needless to say, the full *régime* of exercises described below is not given to tuberculous patients, though some of them are benefited by gentle diaphragmatic breathing exercises prior to undergoing collapse therapy.

Traumatic and inflammatory diseases involving the pleura (for example, gunshot wound of the chest, hæmothorax, empyema) produce: (*a*) deformity of the thoracic cage (postural defects), (*b*) abnormalities in breathing (functional defects). These must be understood before rehabilitating exercises can be intelligently given.

FIGURE I. Patient with penetrating gunshot wound of the chest; entry right axilla; foreign body lodged in front of neck of sixth right rib; right infected hæmothorax producing chronic empyema (drainage tube at back), now five months after injury. No breathing or postural exercises for the first four months. Note contracted right chest, supraclavicular and infraclavicular hollowing, shoulder drawn inwards, backwards and slightly upwards. In a neglected case like this the deformity is very difficult to cure. If suitable exercises and adequate drainage had been commenced early, it would never have developed.

DEFORMITY OF THE THORACIC CAGE.

The deformity of the thoracic cage (see Figures I, II and III) is characterized by diminution in all the dimensions of the affected side of the chest by raising of the diaphragm, scoliosis with the thoracic concavity towards the affected side, and crowding together of the ribs, which are in addition specially depressed over any loculated effusion. The ribs are always more affected than the spine, whose curvature, except in very chronic cases, is not great. These changes begin to appear as soon as the very acute stage of the pleural condition is passed and loculation is commencing, and they develop rapidly. A patient with a sterile hæmothorax may have well-marked deformity within three weeks of being wounded.

The shoulder on the affected side may be lowered, as would be expected from the curve of the scoliosis, but quite often it is raised, especially if a drainage tube has been inserted near the angle of the scapula or if the pleural effusion is basal and the upper compensatory curve of the scoliosis commences in the

[1] Accepted for publication on February 25, 1944.

upper thoracic region. Injury to any of the muscles passing from the trunk to the shoulder girdle or humerus causes the movements of the scapula to be restricted and the shoulder joint to become stiff.

While the patient is confined to bed, his back sinks into the pillows in a kyphotic curve which may take some time to straighten out after he becomes ambulatory.

ABNORMALITIES IN BREATHING.

The abnormalities in breathing are as follows:

1. *Asymmetrical Respiration.*—Asymmetrical respiration is due to diminution in movement, on the affected side, of the diaphragm and ribs, especially over the site of a loculated effusion. Consequently the underlying

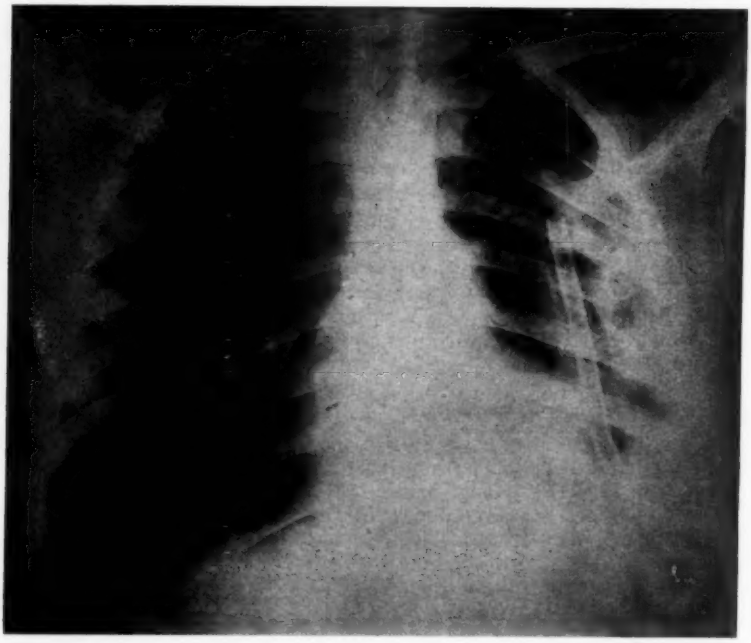

FIGURE II. Postero-anterior film of patient with chronic empyema on left side (tube too far into cavity). Note the diminished area occupied by the left lung on the film, which is an indication of the greatly diminished volume of the left side of the chest. The distance on the film from the fifth rib in the axilla to the centre of the spine is nearly an inch less on the left than on the right, and the dome of the left diaphragm is raised about two inches.

lung does not receive its share of the tidal air, even though in most cases its tissue is potentially capable of normal gaseous exchange, because even if damaged at the outset it is usually healed in three or four weeks.

2. *Premature Inspiration.*—All dyspnœic patients, whatever the cause, tend in their struggle for air to rush the next inspiration before they have completed the previous expiration. In surgical cases this especially affects the good side, which becomes more and more distended with air until its excursion is limited by the fact that inspiration starts from a position very little short of maximum expansion. The patients concentrate all their thoughts and efforts on inhaling the fresh air that they need, forgetting that

there is no room for it if they do not expire all the used air first, and that to get full inspirations their minds should be concentrated on full expiration.

3. *Disproportionate Respiration.*—Normally, breathing at rest is largely diaphragmatic. During exercise expansion of the lower ribs, especially laterally, comes more into play, but movement of the upper ribs and sternum

FIGURE III. Lateral film of chronic empyema to show crowding together of the ribs. The first (partly obscured by the shadow of the pectoral muscles), second and third are normally spaced, but the third, fourth, fifth, sixth and seventh are very crowded, the fourth and fifth so much so that they are nearly touching one another. (The empyema cavity is filled with radio-opaque fluid through the drainage tube, which is drawn upwards. It ought to enter the most dependent part of the cavity.)

forwards and upwards is minimal except on severe exertion. Dyspnœic patients, in addition to inspiring prematurely, frequently bring the neck muscles (and the pectorals if they can fix their arms by holding onto something) into play, exaggerating upper chest movement, and at the same time they tend to neglect to move the lower chest laterally and the diaphragm downwards. This is the cause of "barrel" chest in asthma and chronic bronchitis, but the condition in lesser degree is not uncommon in patients with surgical conditions of the chest who may develop similar disproportion

in the amount of the diaphragmatic, lower costal and upper costal elements in their breathing. (See Figure IV.)

4. *Paradoxical Respiration.*—A few patients with disproportionate respiration actually acquire the habit of relaxing the diaphragm during inspiration so that it rises and much of the costal inspiratory effort is wasted in merely transferring used air from the lower to the upper lobes. This causes a very serious reduction in tidal air. Paradoxical movement of the diaphragm is no myth, for it can be seen on the fluorescent screen. It is suspected when the upper abdominal wall moves backwards during inspiration. This paradoxical respiration is not to be confused with that due to mediastinal flap which results from the mistake of open drainage of an unloculated empyema.

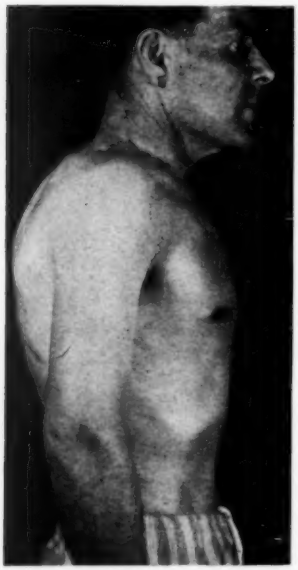

FIGURE IV. Typical barrel chest taken in full inspiration. Note how the sternum bulges forwards and upwards, and how the upper part of the abdomen is concave because the diaphragm has failed to descend. This patient developed an empyema, presumably following a small metastatic lung abscess, during immobilization for a severe compound fracture of the femur caused by a gunshot wound. The drainage opening, now healed, can be seen at the back.

5. *Lower Abdominal Respiration.* — Functionally the abdominal wall consists of two distinct parts: a roughly diamond-shaped upper part between the costal margins and a line drawn on each side from the tip of the tenth costal cartilage to the umbilicus, and a broad lower part stretching like a sling from the lumbo-dorsal fascia round the loins to the *linea alba* from umbilicus to pubis. The function of the lower part is to support the abdominal viscera in the upright position by its tonic contraction. Its movement with respiration should be very slight. The function of the upper part is mainly respiratory. It is very little concerned with support. It acts like a second diaphragm, billowing out when the diaphragm descends and sagging back when it rises, thus reducing the changes in volume of the abdominal cavity during breathing. Lower abdominal breathing describes the state of affairs when most of the abdominal respiratory movement occurs abnormally in the lower part of the abdominal wall.

FIGURE V. Typical deformity associated with lower abdominal respiration. Picture taken at full inspira- after the order to stand at attention. Note kyphosis, lumbar lordosis and protruding lower portion of the abdomen. This soldier is convalescing from an attack of lobar pneumonia.

A surprisingly common postural deformity among supposedly normal soldiers of the "asthenic" type is characterized by kyphosis, lumbar lordosis, exaggerated tilt of the pelvis forwards, and protrusion of the lower abdomen,

which bulges still further during inspiration. (See Figure V.) Some of these men receive chest injuries. Lower abdominal breathing should therefore always be watched for and corrected when present, even though it is not a result of the injury.

THE CAUSES OF THE POSTURAL AND FUNCTIONAL DEFECTS.

The initial cause of the postural and functional defects is reflex nervous action. Irritation of the pleura reflexly inhibits respiratory movement and tends to cause that side of the chest to be held in the contracted position. Pleural pain adds voluntary inhibition. The postural and functional defects may last for months or even years, but the pleural pain lasts only for a few days, and, though experimental proof is lacking, there is no reason to suppose that the inhibitory reflexes act for much longer. The persistence of the deformity must obviously be due to something else.

Fibrous thickening of the pleura is usually alleged to account for it, but the fibrous tissue may disappear while the deformity remains, and suitable exercises can easily overcome any constricting effect the fibrous tissue may have, and actually hasten its disappearance. It is probably much more a parallel than a causative phenomenon.

The real cause is habit. The deformity and abnormal breathing which begin reflexly become established as subconscious bad habits. The ease with which they can be cured by physiotherapeutic methods based on this assumption is the best proof that no other cause is of any material importance.

THE PROGNOSIS OF THE POSTURAL AND FUNCTIONAL DEFECTS AND THE EFFECT OF VARIOUS FORMS OF TREATMENT ON THEM.

The postural and functional defects tend to disappear spontaneously—in children in a few weeks or months, in young adults in a few months or years, in old people only partially if at all. So long as they persist there is diminished exercise tolerance. In a soldier this will probably mean a classification not higher than "B". Such a man at the age of fifty may well be reduced in cardio-respiratory reserve to a level he should not have reached until the age of seventy, and he is likely, after a "B class" life, to die twenty years before his time simply because he has never relearnt how to expand his otherwise normal lung. This is a tragedy, the more so because it is easily avoidable. Since modern surgery and physiotherapy hasten reexpansion of the lung, pleural healing, and the removal of pleural fibrosis, and can restore the majority of war chest cases which reach a base hospital to "A class", the need for suitable exercises, begun early, is established beyond doubt.

Ordinary physical training alone is inadequate. The patient simply refrains from doing exercises which cause respiratory distress, so that his respiratory limitations not only fail to improve, but also prevent full restoration of his general physical fitness. We have had soldiers after treatment without special chest physiotherapy by other surgeons readmitted because shortness of breath prevented them from coping with their duties, and we have cured their disability by a three weeks' course of breathing exercises. It may be argued that army physical training includes breathing exercises. The exercises described in the "Army Manual of Physical Training" are useless, even harmful. They encourage anterior and upper chest breathing with tight abdominal contraction during inspiration, making a barrel chest, and there are no unilateral exercises to overcome the asymmetrical breathing which patients with surgical conditions of the chest have. General physical training is, however, very good as an adjuvant to special breathing and postural exercises, and swimming is excellent.

Since Wolff's bottles are still sometimes seen, it is necessary to point out that blowing water through them is utterly futile. It is one of those things in surgery which, through the dulness of the mass surgical mind, persist long after the indications which originally justified them no longer exist. In the days when open drainage of empyemas only was used and cases occurred in which reexpansion of the lung was delayed, Wolff's bottles were introduced because it was thought that the increased pressure within the lung during forced expiration against resistance would stretch the fibrous tissue in the visceral pleura and help the lung to expand out to the chest wall. It was never pretended that this forced expiratory exercise was a normal respiratory movement, nor that it was designed to restore normal function after the manner of rehabilitating physiotherapeutic measures in general. The patient over-inflated his good lung during inspiration, exaggerating the asymmetry in his breathing, and distended his bad lung during forced expiration, pushing pus and air out of the open drainage tube.

It is more than doubtful whether the bottles ever achieved what was hoped from them, but there was at least a logical reason for trying them. Now, however, we are able to reexpand lungs with the greatest of ease by suction drainage, and the only possible justification for Wolff's bottles has gone. The sooner they disappear from all hospitals and it is realized that modern chest exercises fall into the quite different category of rehabilitating exercises, the better. The modern exercises were originally planned to restore normal posture and function. That in addition they help the flow of pus down the tube, lung reexpansion and pleural healing much more than Wolff's bottles ever did, was a later, though very satisfactory, empirical discovery.

It may be pointed out here that suction drainage aggravates the deformity, so that its use makes breathing exercises more necessary than ever.

CONTROLLED BREATHING.

The modern exercises whose aim is to restore normal and symmetrical shape and movement to the chest may be called exercises in controlled breathing. Unfortunately confusion might arise from the fact that the term "controlled respiration" is applied to the anæsthetic technique sometimes used in chest surgery in which the anæsthetist puts the respiratory centre temporarily out of action by sedatives and washing out carbon dioxide, and maintains aeration of the lungs by rhythmic manual compression of the anæsthetic bag; but it is hard to think of a more suitable term than "controlled breathing" exercises for the exercises to be described below.

Normal breathing comprises diaphragmatic and costal movements. The latter may be further subdivided into upper chest movement (pectoral area) mainly by the first to fifth ribs and the sternum, lateral chest movement (axillary area) mainly by the fifth to ninth ribs, and posterior chest movement (area covered by the *latissimus dorsi*) mainly by the ninth to twelfth ribs. Controlled breathing exercises consist in learning to perform each of these aspects of breathing separately and then in combination in their proper proportions. They may be tabulated as follows:

1. Diaphragmatic (or abdominal)
2. (*a*) Right lateral chest
   (*b*) Left lateral chest

   } These are the most important for all cases.

3. (*a*) Right upper chest
   (*b*) Left upper chest

   } Needed only for patients with an anterior pleural loculus. Many patients with too much upper chest movement have to be taught to suppress it.

4. (*a*) Right posterior chest
   (*b*) Left posterior chest

   } For patients with posterior basal loculi.

5. Full symmetrical deep breathing: For all cases.

The Principles Underlying Training in Controlled Breathing.

It has been pointed out that the postural deformities and functional abnormalities in chest surgical cases persist as bad habits. To get rid of any bad habit, for instance a faulty drive at golf, a person must: (i) appreciate to the full the nature and extent of his bad habit; (ii) learn to overcome it voluntarily; (iii) repeat the correct voluntary movements so often that they become involuntary good habits. The physiotherapist must train patients with chest conditions in just this way. Firstly, they must be made consciously aware of their disabilities by careful explanation. The physiotherapist should have learnt full control of his own chest, so that he can imitate the patient's abnormal movements and posture and demonstrate to him the exercises which will correct them. For ambulatory patients a full length mirror is of great aid in convincing them of their faults. Secondly, they must learn voluntarily to perform each part of breathing separately, one side at a time, concentrating especially on those parts whose expansion has been diminished, and then to combine movement of all parts in the normal way. Finally, they must practise the exercises repeatedly until the habit of normal breathing at all times becomes once more an automatic involuntary process. It will be found that the exercises simultaneously restore to normal the contour of the chest and the curvature of the spine.

Detail of How to Teach Controlled Breathing.

General Points.—To teach a person voluntarily to move his diaphragm without his ribs, and his right ribs without his left, and so on, one must create in him a conscious awareness of these parts of his body as separate entities (cortical representation, in the words of the neurologist). All possible afferent pathways are used to focus the mind on the part to be moved. A hand (at first the physiotherapist's, later the patient's) is placed over it to set up afferent impulses of touch and pressure, and he watches it directly or in a mirror.

In normal breathing inspiration is a short active movement and expiration is a longer, mainly passive, movement caused by relaxation of the inspiratory muscles. These conditions must be preserved during the exercises in which one aims at about two seconds for inspiration and six to ten seconds for expiration, though at first the times will vary greatly in individual cases.

To overcome the common fault of breathing in before completing the previous expiration, every expiration during the exercises must be complete. The only way to ensure this is to make the patient breathe out through the open mouth with the tongue so held as to make a faint, just audible, hissing sound without obstructing the outflow of air. The time for the next inspiration is when the patient cannot hiss any longer because there is no air left to hiss with. If no hissing noise is made, neither he nor his physiotherapist will know whether the chest has been fully emptied down to the residual air or not. At first patients often think that the hissing is rather silly, and try to avoid it. Other patients in the ward are amused by it. But it must be insisted on, not simply by a blunt order, but only after carefully explaining the reason for it, because the success of the exercises depends wholly on the intelligent cooperation of the patient. To get him into the habit of it, it is useful to commence the exercises with a series of deep hissing expirations before bothering him with any special form of inspiration.

Inspiration during the exercises, though a short and determined movement under the nicest voluntary control, must be silent and apparently effortless without any gasping. In their enthusiasm, patients always tend to bring all sorts of accessory muscles into play, grimacing and stiffening their necks and shoulders. Such efforts must be completely discouraged. The

breath may be taken in through the nose or mouth, but as so many patients contract their *alæ nasæ* and obstruct the inflow of air with a loud sniff, it is often better at first to train them to breathe in during the exercises through the open mouth.

To recapitulate, each breath will consist of a short, silent, but perfectly controlled and efficient inspiration through the open mouth, followed by a long, faintly hissing, complete expiration, neither being associated with any violent effort whatever. Each inspiration will start from the "chest empty" position, and air will be drawn only into the part being exercised at the time over which a hand is placed.

Abdominal Breathing.—Abdominal breathing (see Figures VI, VII and VIII) is always the first exercise to be taught. The patient lies semi-recumbent on pillows with a hand placed on the upper part of his abdomen between his xiphisternum and umbilicus, not over or below the umbilicus. The exercise commences with the order, timed to come at the end of an ordinary

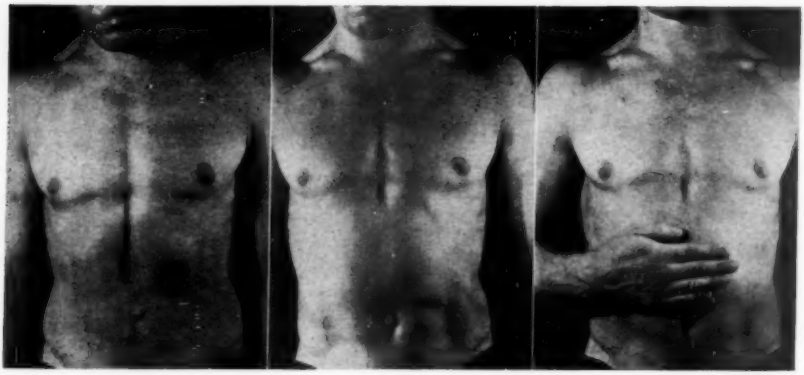

FIGURE VI. Abdominal breathing, at full expiration. Note the concavity of the upper part of the abdomen.

FIGURE VII. Abdominal breathing, full inspiration. Note the convexity of the upper part of the abdomen.

FIGURE VIII. Abdominal breathing, full inspiration, to show the correct position of the patient's hand during the exercise.

inspiration, to breathe out completely with a hiss. Then follows a short, quiet inspiration through the mouth using the diaphragm only, followed by another long, hissing expiration, the same being repeated many times and the costal cage remaining in the "chest empty" position throughout. During expiration the hand moves gently backwards with the abdominal wall as it sags towards the spine, and at the beginning of the inspiration its pressure is increased a little so as to give the expanding abdominal wall a slight resistance against which to push. At first the expansion may be very weak, but as the exercise restores diaphragmatic tone and power, upper abdominal expansion will be possible against a surprising amount of resistance.

In this, as in all localized breathing, the patient must not attempt a really deep breath because this would cause movement of other parts—in this case the ribs—which should remain still. Inveterate upper chest breathers will drag up the *manubrium sterni* even with a small breath, and they must be made to flatten the anterior chest wall during the first full expiration and keep it so throughout the exercises. A second hand placed over it, to stop it moving, may help. Expiration is produced by relaxation of the diaphragm and passive sagging of the upper abdominal wall, and general abdominal contraction, especially with contraction of the *rectus abdominis*, must not

be allowed. Obviously a taut rectus from ribs to pubis will prevent sagging. Also any tendency to lower abdominal breathing must be corrected.

It can be seen that there are many things to be watched, but it is only by attention to every little detail that the full value of the exercises can be obtained.

It may take several sessions spread over a few days before abdominal breathing is mastered. Then lateral chest breathing exercises should be added.

Lateral Chest Breathing (see Figures IX, X and XI).—Patients with surgical conditions of the chest always breathe asymmetrically, moving the affected side less. This should be pointed out to the patient. He will be surprised at the discovery. When he is convinced of his asymmetry and it has been explained that the purpose of the exercises is to restore normal equal movement on both sides, the physiotherapist, with the patient still in the half-lying position, places a hand firmly on each side of his chest well round into the axilla. The exercise is commenced on the good side because this

FIGURE IX. Lateral chest breathing, full expiration, showing the position of the patient's hands.

FIGURE X. Lateral chest breathing, full inspiration, right side only.

FIGURE XI. Lateral chest breathing, full inspiration, left side only.

is easier for the patient and gives him confidence in his ability to perform unilateral costal movement. Just after he has taken an ordinary breath in, the order for him to do the usual hissing expiration is given while the lateral pressure by the hands is increased. When expiration is complete he is ordered to breathe in quietly and quickly, expanding only the good side of the chest in a lateral direction against the pressure of the hand. As it is much easier to do localized expansion of the ribs against pressure, this is kept very firm until towards the end of the inspiration when it is relaxed, only to increase again during the next expiration. The exercise is repeated many times. Throughout its performance the bad side is held firmly with the other hand and not allowed to move, and upper chest and abdominal movements are kept minimal.

Once the patient has grasped the idea of the exercise, he is taught to do it with his own hands, so that he can practise it without help. The pillows must be arranged so that his elbows can project backwards, or his hands will not fit well round into his axillæ and will be placed antero-laterally, encouraging anterior instead of lateral expansion. When the hands are correctly placed there will be a gap of at least six inches between the tips of the fingers.

The exercise is now repeated, the diseased side only being moved. This will, of course, be much more difficult and require intense concentration on the part of the patient, and greater pressure by the hand on the good side to keep it from moving.

In patients with chronic pleural disease whose exercises have been neglected so that they have an immobile side of the chest, it may be impossible to secure true inspiratory expansion of the bad side at first, but there are two "trick" movements of the ribs which can occur without the action of the inspiratory muscles. The physiotherapist can produce the first by pressing very hard during expiration so that the ribs are actually driven in, and then allowing them to come out of their own elasticity during inspiration. The other is a straightening out of the scoliosis during inspiration, a trick which the patient often discovers for himself. Neither of these need be discouraged because the rib movement they produce sets up proprioceptive impulses which help to fix the mind on the appropriate muscles and to give the patient that confidence which will lead to true inspiratory muscular action later.

FIGURE XII. Upper chest breathing, full inspiration, right side only.

Dividing each inspiration into three short successive efforts at expansion against the pressure of the lateral hand also helps rigid patients.

Once the patient has learnt lateral expansion of both sides separately, he should concentrate on the bad side, only taking a few breaths on the good side at each session. When lateral movement on the bad side is showing marked improvement, the unilateral exercises are followed by a series of breaths attempting to move both sides together and equally.

Upper Chest and Posterior Chest Breathing (see Figures XII and XIII).—To patients who have anterior or basal posterior pleural collections with flattening of the ribs over them, upper and posterior chest breathing exercises respectively are given in addition to the above. They are taught in the same way with pressure by the hand over the appropriate part. In the latter case the palms of the patient's hands rest on the lower ribs with the fingers pointing downwards and medially and nearly meeting over the lumbar spinous processes.

FIGURE XIII. Posterior chest breathing, full inspiration, right side only.

Full Symmetrical Deep Breathing.—Full symmetrical deep breathing exercises follow for all patients when they have mastered the exercises for the separate parts. Before they gain this control any attempt at deep breathing results in asymmetrical movement.

Management of the Individual Case.

When Should Breathing Exercises be Started?—Breathing exercises should commence early. It is much easier and better to prevent deformities than to cure them after they have become established. There is no need to wait till the patient is ambulatory or even till the temperature subsides. Ideally, patients with gunshot wounds of the chest and hæmothorax with or without infection will be started in the second week, which for battle casualties usually means as soon as they reach a general hospital. Patients with fractured ribs will be unable to bear pressure on the ribs till towards the end of the third week, but they can do abdominal breathing in the second week. Patients with empyema (non-tuberculous) occurring without trauma should commence exercises as soon as the diagnosis is proved by aspiration of pus, providing any underlying pneumonic process is already resolving. Whenever possible, the exercises should start before operation when a thoracotomy is contemplated and be resumed on the second day after operation. The presence of a drainage tube increases the need for exercises which should never be delayed till the tube is removed.

It may be thought that to oppose a protective reflex tending to rest inflamed parts before the inflammation has subsided must be unwise. In this case it is not so. Once a pleural effusion of blood or pus has begun to absorb or to be aspirated or drained by tube, the protection of rest is no longer necessary, and the voluntary movement of the ribs and diaphragm outside the effusion hastens healing. The most rapid and sure method of obtaining obliteration of a large pleural cavity is by a combination of suction drainage and breathing exercises. Also the exercises are begun very gently at first, and at this stage when excessive movement might be dangerous the patient is not made to breathe more deeply, but merely to learn control of his breathing and to produce respiratory movement in the right places.

Early starting of the exercises, however, throws an added responsibility on the physiotherapist, who must maintain an alert clinical sense so as to know just how much very ill patients can stand without being overtired or subjected to unnecessary pain.

Initial Assessment of Disability.—At the outset the patient's disabilities must be accurately assessed, preferably at a clinical examination by surgeon and physiotherapist together. Even if they see the patient separately they should at least discuss him together, noting any special points such as a tendency to upper chest or lower abdominal breathing. The situation and extent of any pleural collection and the nature of the proposed surgical treatment, especially if and when a thoracotomy is to be done, have to be explained to the physiotherapist to give him an intelligent understanding of the case, so that he will know which exercises need to be specially stressed and will be able to cooperate with the surgeon in the most satisfactory way. He will also need to know if ribs or sternum are fractured and when they will be sufficiently healed for manual pressure on them to be safe.

The Frequency and Duration of Training Periods.—At the commencement of the exercises when the patient is usually still confined to bed, ten to fifteen minutes' individual instruction in the morning and in the afternoon are ideal, though shorter periods will be all that very ill patients can stand. At this stage two periods of a quarter of an hour are far better than one of half an hour. In addition the patient should practise alone at frequent intervals. A routine similar to that of Watson-Jones for quadriceps drill in knee conditions, namely practice for five minutes every hour, is suitable.

When the patient becomes ambulatory it is far better that he go to the physiotherapy department for his exercises. By this time he will usually be sufficiently far advanced to work in a class, and have enough stamina for one

longer period per day of supervised training to suffice. Class work not only saves the physiotherapist's time, but also has the great advantage of stimulating the competitive spirit, which should be exploited to the utmost.

Other Exercises.—Exercises to preserve mobility of the scapula and shoulder are given from the beginning of treatment, and, within the limits of the patient's general physical condition, many other exercises to restore spinal mobility and general physique are added throughout the course at the discretion of the physiotherapist, who will naturally work out his own scheme. The important thing is that the essential nucleus of the treatment, the controlled breathing exercises, will continue to be practised throughout. In the later stages it is wise to include at the end of each session an exercise which will make the patient breathless, and to see that he breathes properly while he is dyspnœic. Also, as soon as the patient's physical condition permits, ordinary physical training, games such as medicine ball, and swimming are excellent.

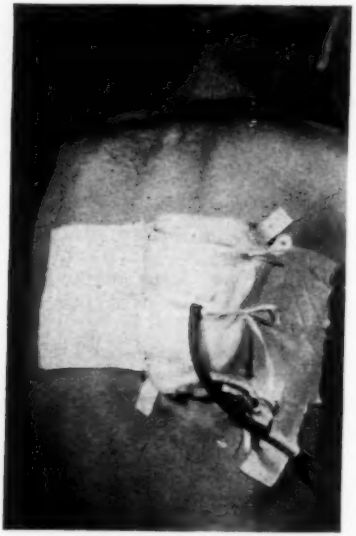

FIGURE XIV. "Corset" dressing for an empyema tube.

Under this heading "other exercises" the optimum time to get a patient with a chest condition out of bed may be indicated. There is no doubt that patients with non-tuberculous surgical conditions of the chest benefit greatly from early mobilization. Providing there is no cardiac contusion or active lung condition, they can be encouraged to move round in bed and help themselves as much as possible once the shock, dyspnœa and perhaps severe toxæmia of the first days have passed and any excessive blood loss has been restored by transfusion. Later an evening temperature below about 99·6° F. need not of itself prevent them from sitting out of bed or even commencing to walk a little each day, and they should never be kept in bed simply because of a drainage tube connected to a bottle. The tube can be clipped off and disconnected for a few hours in the morning and again in the afternoon while they get about. The exercise of ordinary walking improves the posture, appetite, sleep and, most important of all, morale of the patient, who should never be allowed to get the idea that he is a fragile invalid.

Nursing Points Related to the Physiotherapy of Chest Cases.—Dressings, including those around tubes, should be fixed by tying tapes across them in the form of a "corset" (see Figure XIV). The tapes loop through two pieces of adhesive strapping stuck to the skin on either side of the wound with a gap of about three inches between them. Encircling bandages or binders are not efficient at keeping dressings from slipping downwards or round the body, even when they are very uncomfortably tight, and they tend to kink tubes, impede respiration, and make it difficult for the patient to do his exercises and impossible for the physiotherapist to observe whether his rib movement is satisfactory. To give proper training in controlled breathing, the physiotherapist is therefore obliged to remove the binder at each visit. The dressing promptly falls off, allowing contamination of the wound, and as often as not the physiotherapist gets pus on his hands. The nursing staff, far from being apologetic, usually reacts with loud complaints because they

have to repeat the dressing. Indeed, so unsatisfactory are binders that a glimpse of one on a patient with a chest condition in a ward precipitates the same feeling of disgust as the sight of a leg plaster with the foot dropped and toes clawed. Both show a parallel lack of appreciation of functional requirements, and both lead to an immediate estimate of the capabilities of the person in charge as a chest or orthopædic surgeon as the case may be, which is hardly flattering.

It is of great advantage if the members of the nursing staff have eyes which notice the patient's deformity so that they will arrange his pillows to support him lying symmetrically, and rearrange them whenever he slips over to the affected side as patients with chest conditions always do. Their cooperation is also necessary to see that the patient practises his exercises during the day when the physiotherapist is away. It takes all the combined endeavours of surgeon, physiotherapist and nursing staff by argument, persuasion, or any other ruse to keep the patient's interest in his exercises from flagging. Only with such team work are the best results obtained. For these and many other reasons outside the scope of this paper patients with chest conditions should be collected together in the one ward.

Assessment of Preparedness for Discharge.—The aim is always to restore full vital capacity. A few patients such as those in whom several ribs are shattered and reunite in a collapsed position, will have some permanent disability, but the majority can become normal again. This is judged to have occurred when the chest shows normal shape and breathing is normal and equal on both sides, and the patient's capacity for exertion is equal to what it was before the injury or disease.

Inspection and palpation are sufficient to detect asymmetry, but measurement of the circumference of each side of the chest separately at a suitable fixed height on full expiration and full inspiration at the beginning and at the end of treatment gives useful figures for inclusion in case records. This can easily be done with sufficient accuracy for present purposes by cutting a tape measure in half and reuniting it with the two ends to the middle, which an assistant holds over a spinous process at the required height while the new ends are crossed horizontally over the mid-line in front, each giving the measurement of its side of the chest. To estimate capacity for exertion, simple exercise tolerance tests can be devised and the time for the pulse and respirations to return to the resting rate noted, and if a spirometer is available vital capacity figures are a useful guide.

Soldiers are discharged to a convalescent depot before rehabilitation is complete, but so long as the pleura is healed and the chest movement symmetrical before they leave hospital, recurrence of asymmetry need not be feared. Once symmetry of chest form and movement is restored, the convalescent depot *régime*, including ordinary physical training, is all that is necessary to complete the restoration of vital capacity and physical stamina.

Patients with hæmothorax without infection should be ready for convalescent depot in an average of five weeks after injury. The exercises will not have allowed any deformity to develop, and the last remnants of blood left after aspiration will have been absorbed by that time. Another three weeks at the depot usually make them fit to return to their units. Patients with pleural infection needing tube drainage will take longer, but the course of exercises will have achieved its object, and they will be ready for convalescent depot as soon as the tube is out and the sinus healed. With good treatment extremely few of them should be longer than six months away from their units. Thus chest conditions resemble soft tissue injuries of similar extent (for example, in the thigh or buttock) in their healing time and duration of

unfitness for duty, and when they are associated with compound fractures of long bones or nerve injuries, it is nearly always these which determine the total duration of illness and the ultimate board classification. Even the occasional patient who needs a thoracotomy for removal of a foreign body from lung or pleura has an excellent chance of speedy return to complete normality.

SUMMARY.

1. The nature of the postural and functional defects associated with traumatic and inflammatory diseases of the pleura, their causes and their prognosis are described.

2. The physiotherapeutic treatment termed "controlled breathing" is explained. The physiological principles underlying it and the method of teaching it are given in detail. It should be the basis of all physiotherapeutic courses for patients with surgical conditions of the chest.

3. The management of the individual case is discussed from the physiotherapeutic point of view, together with nursing points and the results to be expected—namely, the return of the majority to "A1" health in two to six months.

ACKNOWLEDGEMENTS.

I am indebted to Major-General Burston, Director-General of Medical Services, for permission to publish this paper; to Lieutenant-Colonel E. S. J. King for permission to use patients in the surgical division of a military hospital as subjects for the photographs illustrating the deformities; to the photographer at the hospital for taking the pictures; and to Corporal Jorgensen for posing for the photographs illustrating the breathing exercises. As indicated at the beginning of the paper, I owe my original training in this work to Mr. J. E. H. Roberts and other members of the Brompton Hospital staff, though the paper also includes suggestions and views arising out of my own experience.

Case Reports.

A CASE OF OVARIAN PREGNANCY.[1]

By A. Eisdell Moore,
Auckland.

Clinical History.

The patient, Mrs. M., aged twenty-nine years, was admitted to hospital on July 1, 1942, complaining of generalized lower abdominal pain which had been present for some three months. The pain was of a continuously nagging type, but was increased definitely by any physical strain.

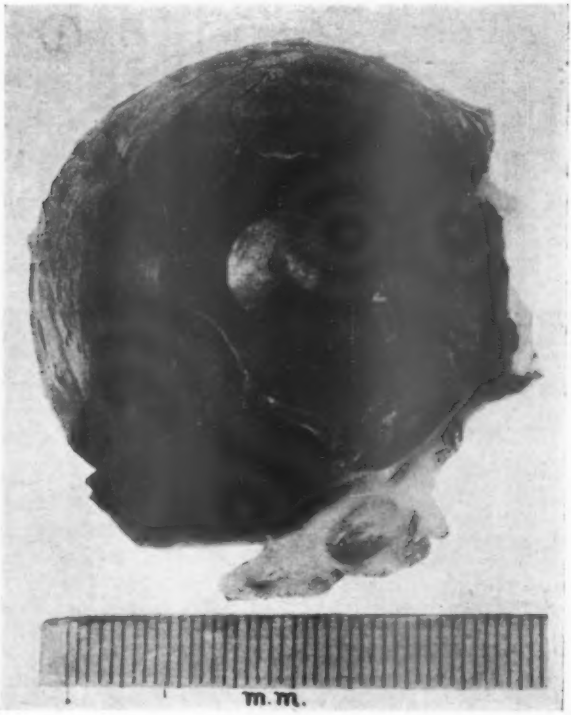

Figure I. Specimen showing amniotic cavity in the ovary and the fœtus (1·3 centimetres long) attached by cord.

Her previous history was unimportant except for an operation for peritonitis arising from appendicitis at the age of six. She had two children, one aged four and a half years and one two and a half years. Menstruation had always been irregular, with very scanty periods and pre-menstrual backache. She was uncertain when her last period had occurred, but thought it was about four or five weeks prior to admission.

Examination of her abdomen revealed a big depressed scar in the right iliac region. There was slight generalized resistance all over the abdomen, but no marked tenderness.

[1] Accepted for publication on March 30, 1943.

FIGURE II. Photomicrograph × 58. a = follicle, b = decidual cells, c = blood clot.

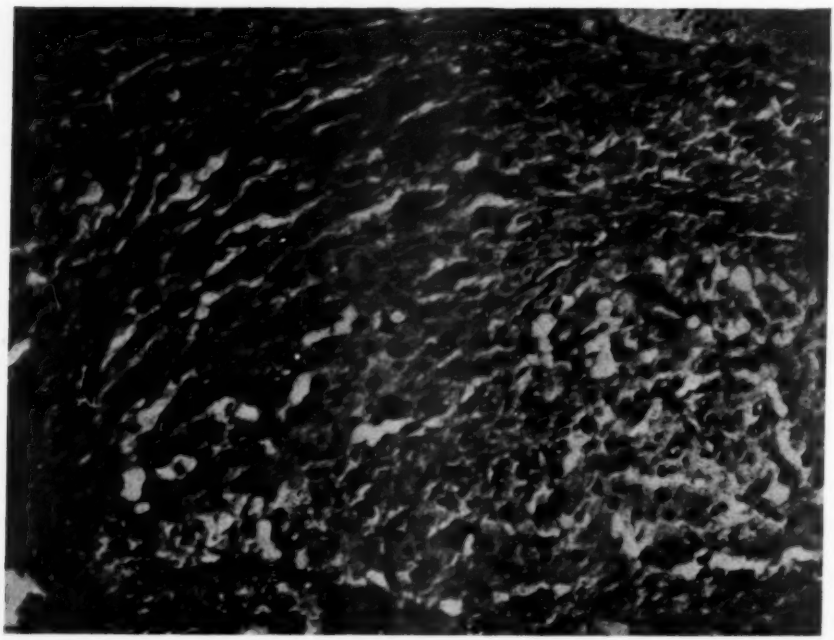

FIGURE III. Photomicrograph × 230. Decidual cells.

Examination *per vaginam* revealed a uterus normal in size and consistency, lying in a retroverted position, which it was not possible to correct. In the left fornix there was a tender firm lump about the size of a turkey's egg. Routine examination of the rest of the body revealed nothing else abnormal. A diagnosis of tubo-ovarian mass was made, the nature of which was doubtful.

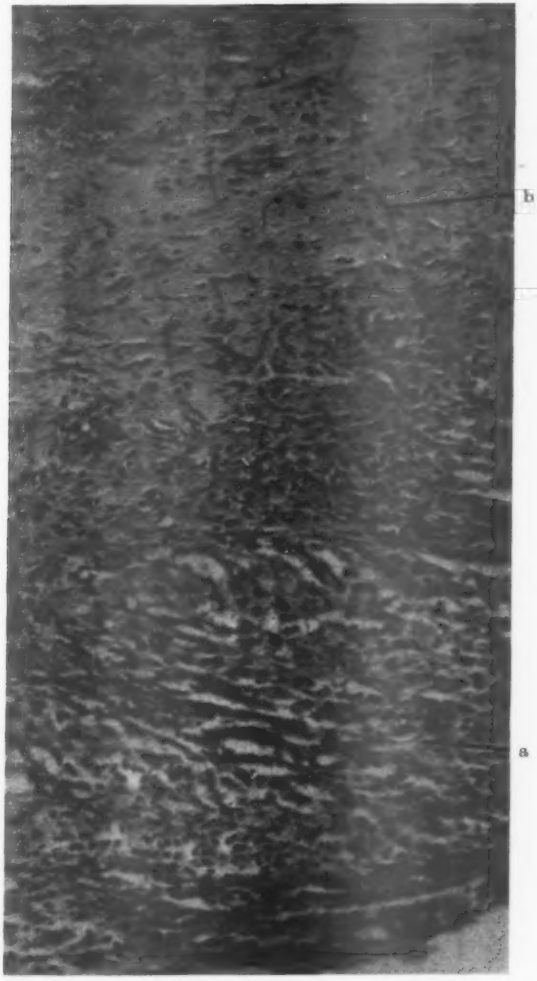

FIGURE IV. Photomicrograph × 160. a = decidual cells, b = ovarian stroma.

Operation was performed on July 2, 1942, through a mid-line subumbilical incision. The uterus was found in a retroverted position, and a tense, dark cyst of the left ovary, about the size of a tennis ball, was found attached to the back of the left broad ligament. It had no association with the left tube or round ligament, which were apparently quite normal. The cyst was removed.

The structures on the right side of the uterus were normal.

Numerous adhesions between coils of small intestine were found in the right iliac fossa and one coil of bowel was actually attached to the sunken skin of the old

operation scar. The adhesions were freed, the scar was excised, and the weak abdominal wall was repaired by fascial overlap.

For about a week after her operation there was considerable abdominal distension, for which it was necessary to keep the stomach emptied by means of a Rehfuss tube and to administer saline solution continuously by intravenous drip. This condition of subacute ileus was considered to be due to the amount of damage that had had to be inflicted on the peritoneal covering of the small bowel during the extensive freeing of adhesions.

Apart from this mild ileus, convalescence was normal; the wound healed by primary union, and the patient was discharged in the fourth week after operation.

Pathological Report on the Specimen.

The specimen consists of a spherical mass 4·5 centimetres in diameter, on one side of which ovarian tissue can be distinguished. On section there is revealed a cavity, lined by amnion and containing a fœtus, 1·3 centimetres in length, attached to the wall by its umbilical cord (Figure I). The cavity is surrounded by blood clot.

Sections from various parts show that, adjacent to the clot, the ovarian tissue has developed large vascular spaces and there is development of decidual cells from its stroma; in the clot chorionic villi occur (Figures II, III and IV). The ovary contains a number of follicular cysts which, with some fibrosis of the stroma, indicate a chronic oophoritis. Growing from the wall enclosing the blood clot is a small pedunculated cyst.

The close relationship of the clot to the ovary and the changes in the ovarian stroma and vascularity point to a primary ovarian pregnancy.

Discussion.

Primary ovarian pregnancy is the very rare condition in which the fertilized ovum undergoes a certain stage of its development entirely within the ovary.

This condition is distinguished from secondary ovarian pregnancy in which the fertilized ovum, having undergone some of its development in a nearby structure, usually the Fallopian tube, subsequently becomes implanted onto the ovary.

Primary ovarian pregnancy can originate only by fertilization of the ovum when the follicle has just burst and the opening is not yet sealed off. The ovum must lie near the seat of rupture, and some authorities maintain that the ovum must have special powers of adherence.

It is considered that primary ovarian pregnancy indicates some pathological change in the ovary, whereby ovulation is interfered with, and that this is probably in the nature of a thickening of the theca or some chronic ovaritis.

Recently an investigation into cases that have been published was made by Russell and Black, whose work is referred to in the *American Journal of Obstetrics and Gynecology* for 1941.[1] They were able to discover 85 supposed proved cases of primary ovarian pregnancy, but they considered that only 52 of these cases fulfilled the criteria necessary for establishing the pregnancy as definitely of primary nature.

These conditions were originally laid down by Spiegelberg in 1878, and are as follows:[2] (i) The tube on the affected side must be intact. (ii) The fœtal sac must occupy the position of the ovary. (iii) The sac must be connected with the uterus by the ovarian ligament. (iv) Definite ovarian tissue must be found in the sac wall.

In the case described these requirements were fulfilled, together with recovery of the fœtus in the fœtal sac.

Acknowledgement.

I am indebted to Dr. Walter Gilmour for the pathological report on this case and for the preparation of the plates. It is with much gratitude that I express my appreciation of his assistance.

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[1] B. P. Russell, junior, and W. T. Black, junior: "Primary Ovarian Pregnancy", *The Southern Surgeon*, Volume ix, 1940, page 114, abstracted in *American Journal of Obstetrics and Gynecology*, Volume xli, 1941, page 542.

[2] E. W. Titus: "Ovarian Pregnancy", *American Journal of Obstetrics and Gynecology*, Volume xxxviii, 1939, page 516.

PERFORATION OF THE INTESTINE BY AN INGESTED SHARP FOREIGN BODY.[1]

By W. R. McKechnie,
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A review of the literature on the subject of ingestion of sharp foreign bodies reveals that it is not a rare occurrence. The first recorded case is that of Amyard Claudius (1735), quoted by Deaver.[1] A boy, aged five years, had a scrotal hernia, irreducible, and a discharging sinus of the right thigh. Operation revealed the appendix wrapped in omentum lying in the hernial sac. The appendix was successfully removed, and it was found to be perforated by a pin, the head of which remained within the cavity of the appendix. The child recovered.

In 1899, Mitchell[2] described 32 cases. Carp[3] (1927) reported 48 cases. J. E. McManus[4] (1941) reviewed 93 cases in the literature and added two further cases involving the ileo-caecal region. Cases of perforation by blunt objects were not reviewed because it is usually impossible to be certain of the primary role of the foreign body in the evolution of the pathological condition.

Approximately 50% of perforations occurred in the first three decades of life, but only 18% were found in the first decade. The sex has been reported in 87 cases; in these, 51 patients were male and 36 female, but it is difficult to explain the sex disproportion. The type of ingested sharp object can be graded broadly into three groups: (*a*) metallic bodies, (*b*) animal bones, (*c*) wood splinters.

The exact site of perforation has been described in 90 cases. Contrary to expectations, the relatively fixed points and the narrowed lumina of the gastro-œsophageal junction, the pylorus and duodenum were the sites of very few perforations. Five occurred in the gastro-duodeno-jejunal region. The lower ileal and caecal regions included 63 cases, which on subdivision showed perforation in Meckel's diverticulum, 10 cases; lower ileum, 10; caecum, 10; appendix, 33. Perforation occurred in the colonic region 15 times, in the hepatic flexure region three, in the transverse colon one, in the splenic flexure two, in the descending colon one, in the sigmoid five, in the rectum three. No visible perforation was found in seven cases, but the foreign bodies were found in abscesses in various recesses of the abdominal cavity.

Duration of symptoms varied from three hours to twelve years, but the usual period ranged from three hours to two weeks. There was no apparent relationship between the site of perforation and the duration of symptoms. Two types of perforation were recorded: the dramatic and the undramatic. The former was heralded by sudden, sharp, severe, constant mid-abdominal pain followed by vomiting due to sudden intestinal perforation and progressive peritonitis. It was noted that the shock which is associated with perforated peptic ulcer was not described or recorded. In the undramatic and non-urgent type there developed gradually the clinical picture of a localized peritoneal mass with the symptoms and signs of abdominal pain, pyrexia, anorexia and localized tenderness. In the three rectal cases there was a constant clinical picture of tenesmus, diarrhœa, melena, complicated by peritoneal signs of pain, perineal tenderness and œdema and pyrexia.

Ninety-three of ninety-five patients offered a history sufficient to determine a particular pathological change which could be divided into five types as follows: (*a*) early localized peritonitis, (*b*) indurated inflammatory mass or tumour, (*c*) abscesses, (*d*) general peritonitis, (*e*) hæmorrhage.

The mortality among 93 patients was 25·9%. An arbitrary division into cases occurring before and after 1900 was made. Mitchell's[2] review in 1899 contributed a mortality of 53·3% for 32 cases, and practically every fatality occurred without surgery. Those patients who recovered, discharged their abscess contents and then recovered. From 1900 to 1940 there was a mortality of 10% in 60 cases. This marked difference in mortality is a measure of medical progress in the early recognition and effective treatment of acute peritoneal inflammation and infection.

Clinical History of a Case.

On December 13, 1942, a twenty-two-year-old soldier was ruminating with a three-inch nail between his teeth. He unfortunately laughed and swallowed the nail. He did

[1] Accepted for publication on June 26, 1943.

not report the accident. On December 16, 1942, he noticed a sensation of pricking and heat in the perineal region during micturition. He consulted his medical officer, who found no other urinary signs. The soldier was put under observation. On December 17, 1942, the perineal sensation of heat and pricking was a little worse. On the same night he passed a little red blood at the end of micturition. On December 18, 1942, the patient felt uncomfortable in the perineal region all day and had no further urinary signs. During the night he developed severe acute perineal pain, two-hourly frequency of micturition, severe pain and tenderness on micturition and slight but definite hæmaturia at the end of the act. He was unable to rest or sleep and any movement caused agonizing pain and tenderness in the perineum. On December 19, 1942, at 8 a.m. he was admitted to the Kaitaia Hospital.

On examination the patient was a well developed male, who presented an anxious expression and signs of obvious distress either at rest or on moving. The pulse rate was 96 in the minute, but temperature and respiration were normal. Immediately on admission, he passed four and a half ounces of urine which contained obvious blood. Micturition caused acute pain. He passed the urine in small amounts at intervals of a few seconds. Suprapubic abdominal palpation caused a mild degree of tenderness over this area and a desire to micturate. Perineal inspection presented no abnormality, but palpation caused acute pain and tenderness. A thin, hard, elongated, round object, resembling a nail, was located deeply in this region. The presenting part had a sharp point, and appeared to be in contact with the membranous urethra.

A fine round soft rubber catheter was passed up the urethra into the bladder with no obstruction, but its passage across the membranous urethral lumen caused marked pain and tenderness. An X-ray examination in two positions revealed the presence of a foreign body, resembling a nail, situated in the perineum. The nail was approximately parallel to the course of the prostatic urethra with the point apparently in close apposition with the membranous portion of the urethra. Proctoscopy revealed no detectable rectal perforation. No other investigations were deemed necessary.

Operation was performed under "Pentothal" anæsthesia with the patient in the lithotomy position. A short deep incision was made into the perineal region down to the sharp pointed end of the nail. This was located by careful blunt dissection, although bleeding was a little troublesome. The pointed end of the nail was grasped with blunt forceps and carefully extracted. There was no detectable urine following this manœuvre. The wound was closed with interrupted mattress sutures without drainage.

Post-operative care consisted of the free administration of fluids and a careful watch on the urinary output. The patient passed urine within six hours of operation; the act was accompanied by a little difficulty and tenderness. At the end of thirty-six hours the patient had no hæmaturia and he was completely free of his previous urinary symptoms and signs. He had an uneventful convalescence. Follow-up some weeks later revealed him to be symptomless and totally free of any complications.

Discussion.

It seems probable that the nail perforated the sigmoid colon or rectum without causing any recognizable symptoms, and came to lie between the bladder and prostate in front and the rectum behind. The nail finally occupied a position in contact with the membranous urethra to set up the urinary syndrome. The history, symptoms, signs, urethral instrumentation, negative proctoscopic findings and radiological appearances made a diagnosis of an extraurethral foreign body reasonably certain. Surgical removal was direct and simple. Recovery was uneventful and no complications were encountered.

Summary.

1. A report is given in detail of a perforation of the alimentary tract by an ingested sharp foreign body.

2. A study of ninety-three cases of similar lesions reveals no urinary syndrome as described in this case.

3. Surgical removal by the perineal route was successful. Convalescence was normal and there were no complications.

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(2) J. F. Mitchell: "The Presence of Foreign Bodies in the Vermiform Appendix Caused by Foreign Bodies", *The American Journal of Surgery*, Volume xvii, 1932, page 66.

(3) L. Carp: "Foreign Bodies in Intestines", *Annals of Surgery*, Volume lxxxv, 1927, page 575.

(4) J. McManus: "Perforations of the Intestine Caused by Ingested Foreign Bodies", *The American Journal of Surgery*, Volume liii, 1941, page 393.

INTRAVENTRICULAR RUPTURE OF A BRAIN ABSCESS FOLLOWING CAVERNOUS SINUS THROMBOSIS: REPORT OF A CASE WITH RECOVERY FOLLOWING SULPHONAMIDE THERAPY.[1]

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(From a Military Hospital for Head Injuries, England.)

CAVERNOUS sinus thrombosis and intraventricular rupture of a brain abscess are both comparatively rare conditions and are both usually fatal. The case reported in this paper is probably unique in that these two conditions occurred in a patient who later recovered.

Clinical History.

History of Cavernous Sinus Thrombosis.

W.G.M., aged twenty-two years, a corporal fitter in the Royal Air Force, had always been in excellent health until May, 1941, when he developed two boils on the left side of his neck. Two weeks later (May 28) he was admitted to the Burntwood Emergency Hospital under Dr. C. G. Parsons with an acute spreading cellulitis extending from the upper part of the neck to the left side of scalp and forehead. His temperature was 104° F., his pulse rate was 100 per minute, and his respirations numbered 26 per minute. He was given "Prontosil" 1·0 gramme every two hours. Next day he was delirious and unresponsive, and the inflammatory area had spread to involve the left orbit. His fever now became intermittent up to 102° F. During the succeeding forty-eight hours he developed considerable protrusion of the left eyeball with marked swelling of the eyelids and conjunctiva and a marked external ophthalmoplegia. The left pupil was dilated and reacted only to consensual light stimulation; the left optic fundus was blurred and shortly afterwards developed many hæmorrhages and an apparent thrombosis of the retinal vessels. The right eyeball showed only slight proptosis and chemosis. In addition to the ocular manifestations the patient had a cough with offensive sputum and dulness at the right pulmonary base. Small subcutaneous abscesses appeared behind the left ear and in the left forearm; a culture grown from the retroauricular abscess contained *Staphylococcus aureus*. This organism was also grown in a blood culture and on culture of the urine, which contained a few pus cells. The leucocyte count was 30,000 per cubic millimetre (90% polymorphonuclear leucocytes).

A diagnosis of cavernous sinus thrombosis with pyæmia due to the staphylococcus was therefore made, and starting two days after admission (May 30) he was given sulphathiazole in doses of 1·0 gramme every four hours, at first intravenously and later by mouth. By June 3 he had begun to improve and had become responsive once more. Shortly afterwards the degree of proptosis of the left eyeball lessened and the ocular movements began to improve. The left eye, however, was permanently blind. Although general improvement continued slowly, he retained an intermittent fever up to 100° F. with occasional peaks up to 102° F. In July he started to complain of intermittent frontal headaches. Neurological examination showed that the protrusion of the eyeballs had now disappeared, but that on the left side there was still a partial external ophthalmoplegia. The right masseteric and temporal muscles were wasted and slightly weaker than on the left, and were associated with slight subjective numbness over the right side of the lower part of the face, as well as with paralysis and sensory loss affecting the right half of the palate. No weakness or sensory change was observed in the trunk or limbs, but the left plantar response was extensor and the right sometimes extensor and sometimes flexor. The cerebro-spinal fluid on lumbar puncture at periodic intervals was found to contain more than 300 cells (mostly lymphocytes) per cubic millimetre and a protein content of more than 240 milligrammes *per centum*. The intrathecal pressures appeared raised, and the withdrawal of cerebro-spinal fluid was usually followed by temporary relief of headache. By October the patient was having only occasional

[1] Accepted for publication on October 26, 1943.

elevations of temperature up to 100° F. and his condition seemed improved. On October 13, however, he had a generalized epileptic convulsion, and on the following day was found to have some weakness of the right upper limb and some dysphasia which disappeared a few days later. He was invalided from the Royal Air Force shortly afterwards.

History of Cerebral Abscess.

On October 28 he was transferred to a military hospital for head injuries under the auspices of the Ministry of Pensions. His temperature had now become normal. Mentally he was alert but euphoric, and had no complaints other than complete blindness in his left eye. Examination showed him to be wasted but without visible signs of residual infection. The following positive neurological signs were observed: the left pupil was dilated and inactive to direct light, though it reacted briskly to consensual light stimulation; marked atrophy of left retina with sclerosis of vessels was present; wasting and weakness of right masseteric and temporal muscles were associated with diminution of the right corneal reflex and slight numbness of the right upper lip; slight weakness affected the whole of the right side of the face and slight deafness of middle ear type was present in the right ear; slight increase of tendon jerks was noted in the left lower limb without weakness, ataxia, or sensory loss; the left plantar response was constantly extensor, while the right plantar response was sometimes extensor and some-

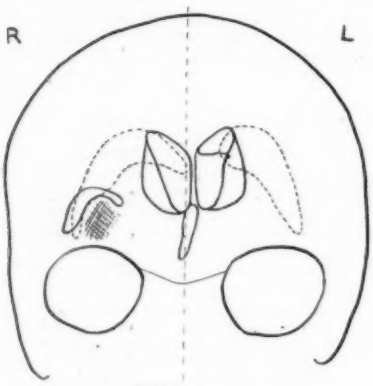

FIGURE I.

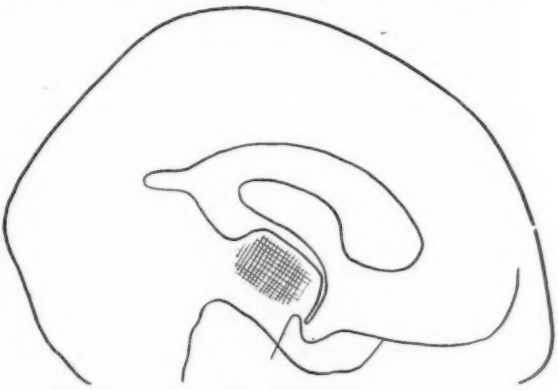

FIGURE II.

Tracings of encephalograms made on January 20, 1942, showing site of space-occupying lesion, presumably an abscess, in cross-hatching.

times flexor. The clinical picture therefore was one of old thrombosis of the retinal vessels in the left eye, slight paresis of the right fifth, seventh and possibly eighth cranial nerves, and minimal signs of pyramidal disturbance affecting the left lower limb. Important negative observations in view of subsequent events were that the right optic fundus was normal and that the visual fields remained full to quantitative perimetry. Repeated examination of the lumbar cerebro-spinal fluid showed that the cell count varied from 55 to 250 cells, the cells being mostly lymphocytes, with a protein content of between 100 and 240 milligrammes *per centum*. The lumbar puncture pressures were between 100 and 160 millimetres, with free rise and fall of the intrathecal pressures on compression of either right or left jugular vein separately. The leucocyte count was 7,800 per cubic millimetre, with 62% polymorphonuclear leucocytes. X-ray pictures of the skull were normal, and a cisternal encephalogram on November 11 seemed normal, except that neither temporal horn was filled satisfactorily.

In view of the persistent increase of cells in the cerebro-spinal fluid, the patient was suspected of suffering from brain abscess and was kept in bed. He had two further major epileptic attacks, one of which was observed to begin with conjugate deviation of the eyeballs to the left side. On January 20, 1942, cisternal encephalography was repeated, and revealed a small localized elevation in the anterior part of the floor of the right temporal horn associated with a very slight shift of the whole ventricular system to the left side (Figures I and II). The diagnosis suggested a small deeply placed abscess in the right temporal lobe adjacent to the ventricle. Nine days later the patient rapidly developed signs of acute meningitis with irritability, drowsiness and fever up to 102° F. On lumbar puncture the cerebro-spinal fluid was turbid and under raised pressure. It contained 6,400 white cells (90% polymorphonuclear leucocytes) per cubic millimetre and 240 milligrammes of protein *per centum*. Cultures subsequently could not be grown.

A clinical diagnosis of rupture of the abscess into the ventricle was put forward, and an attempt was then made to locate and aspirate the abscess. Under local anæsthesia a burr hole was placed low down in the right temporal fossa, and the right temporal lobe was systematically explored with an aspirating brain needle without encountering pus. Once the needle tapped the right temporal horn at a depth of six centimetres from the dura and two cubic centimetres of turbid cerebro-spinal fluid were obtained; it contained 5,200 white cells (80% polymorphonuclear leucocytes) per cubic millimetre and more than 400 milligrammes of protein *per centum*. When the needle was directed in a more forward direction slightly increased resistance to its passage was encountered at a depth of 4·5 centimetres. Several worms of œdematous tissue were obtained in the eyelet of the

TABLE I.

Lumbar Puncture Findings Following Intraventricular Rupture of Cerebral Abscess on January 29, 1942.

Date.	Pressure in Millimetres of Water.	White Cells per Cubic Millimetre.	Protein (Milligrammes per 100 Cubic Centimetres).
January 29, 1942..	Increased	6,400 (90% polymorphonuclear cells)	200
February 1, 1942	300	880 (90% polymorphonuclear cells)	600
February 3, 1942	—	620 (80% polymorphonuclear cells)	480
February 7, 1942	200	360 (70% polymorphonuclear cells)	360
February 10, 1942	170	920 (70% lymphocytes)	350
February 16, 1942	160	250 (80% lymphocytes)	460
February 24, 1942	—	88 (82% lymphocytes)	400
March 6, 1942 ...	140	61 (90% lymphocytes)	200
March 17, 1942 ...	270	23 (95% lymphocytes)	140
March 31, 1942 ...	120	31 (96% lymphocytes)	160
April 7, 1942	90	6 (all lymphocytes)	90
April 28, 1942	150	7	120
May 13, 1942	—	6	35
July 3, 1942	90	2.	40

exploring needle, and were examined histologically by Dr. Dorothy Russell, who reported as follows: "Three films in Schaudinn's fluid showing diffuse subacute purulent infiltration of cerebral tissue, considerable gliosis and focal cuffing of blood vessels with leucocytes. The appearances strongly suggest reaction about a chronic abscess."

Following this unproductive intervention, sulphathiazole was administered in large doses and once again the patient's condition began to improve. Within four days his temperature had fallen to under 100° F. and shortly afterwards it became normal. He appeared bright and cheerful once more, exhibiting no increase in the neurological signs. Lumbar punctures, repeated at frequent intervals, showed slow and steady improvement in the cerebro-spinal fluid (Table I). By early April the cell count of the lumbar cerebro-spinal fluid had fallen to six cells per cubic millimetre and the protein

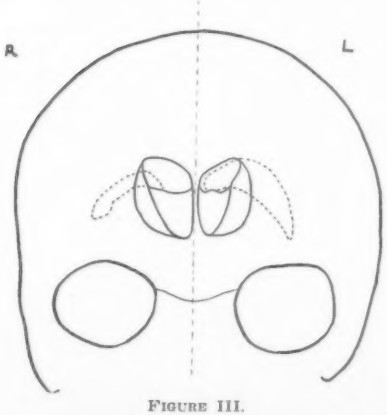

FIGURE III.

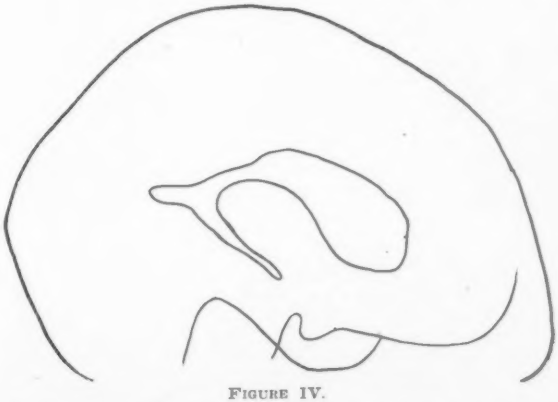

FIGURE IV.

Tracings of ventriculograms made on April 7, showing stenosis of posterior half of right lateral ventricle.

content to 90 milligrammes *per centum*; simultaneously the weakness and numbness of the right side of the face had disappeared, but the alteration of reflexes in the left lower limb was still present. On April 7 ventriculography was performed under local anæsthesia to ascertain what had happened to the abscess in the right temporal lobe. Both lateral ventricles were readily located; the cerebro-spinal fluid was slightly abnormal in the right ventricle and normal in the left (right ventricular cerebro-spinal fluid: cells 4, protein 40 milligrammes; left ventricular cerebro-spinal fluid: cells 0, protein 25 milligrammes). The radiological appearances of the ventricles, however, were most unusual (Figures III and IV). The posterior half of the right lateral ventricle, including body, vestibule and the occipital and temporal horns, was greatly narrowed with nodularity and blurring of its outline. There was no shift or displacement of any part of the ventricular system, and thus no evidence of a space-occupying lesion. The appearances indicated a focal stenosis, presumably cicatrical, of the right lateral ventricle. Shortly

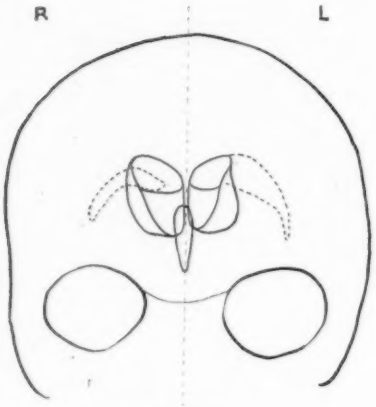

FIGURE V.

FIGURE VI.

Tracings of ventriculograms made on July 6, showing no progression in the stenosis of the right lateral ventricle. Pathological process now presumably quiescent.

after this investigation the cerebro-spinal fluid became normal and the neurological signs, with the exception of the permanent blindness of the left eye and the dilatation of its pupil, cleared up. The patient was by now undertaking active physical exercises and on May 21 was allowed to go home.

He returned some six weeks later for reexamination. In the interval he had been doing light jobs without distress and had been bicycling ten miles a day. The left eye now showed a well-marked *retinitis proliferans* (Dr. Ida Mann) and neurological examination was now "otherwise negative". His general health and intelligence were normal. The electroencephalogram was normal. Ventriculography was repeated on July 6 and showed the same appearance of the right ventricle noted three months earlier without alteration or progression. The lumbar and both ventricular cerebro-spinal fluids were normal (lumbar cerebro-spinal fluid: cells 2, protein 20 milligrammes; right ventricular cerebro-spinal fluid: cells 2, protein 20 milligrammes; left ventricular cerebro-spinal fluid: cells 1, protein 10 milligrammes). The patient was discharged as cured of his intracranial infection.

Discussion.

The clinical picture at the commencement of this patient's illness presented all the hall-marks of the fulminating type of septic cavernous sinus thrombosis—high fever and delirium, ocular proptosis with oculomotor nerve palsies, engorgement and chemosis of orbital tissues, pyæmia with positive blood culture. Until the advent of the sulphonamide drugs, cavernous sinus thrombosis of this severity was almost invariably fatal. During the past few years, however, several cures have been reported following the administration of sulphanilamide, sulphapyridine, sulphathiazole and similar drugs ("Annotations", *British Medical Journal*, 1942),[1] and a few such cases have been observed in neighbouring hospitals. The dramatic improvement observed in this case following the institution of sulphathiazole therapy is therefore no longer unusual, but the case is exceptional in that after the acute features had subsided a subacute or

chronic intracranial infection lingered on for many months and a brain abscess developed, which later discharged into the ventricle before recovery eventually occurred.

The form in which the intracranial infection persisted during these months was probably as a patchy thrombophlebitis affecting cerebral veins and venous sinuses. It is known that in cavernous sinus thrombosis the inflammatory process spreads to neighbouring venous channels (Turner and Reynolds, 1931),[2] and direct evidence of this was afforded in the case described here by the observation of thrombosis of the retinal vessels. Such spread probably occurs in a patchy manner, especially when the infection is subacute or chronic. On this basis we can explain those neurological signs observed in this case, which indicated multiple foci of disturbance within the cranium—namely, the pyramidal signs in the left lower limb, epileptic attacks commencing with excitation of the right frontal lobe, fleeting dysphasia and weakness of the right lower limb, and paresis of the right fifth and seventh cranial nerves. We can also account for the persistent pleocytosis and increased protein in the cerebro-spinal fluid and for the subsequent development of a cerebral abscess presumably within the area of distribution of one of the thrombosed vessels (Symonds, 1940).[3]

Brain abscesses, both acute and chronic, consequent on cavernous sinus thrombosis have been reported at post-mortem examination (Eagleton, 1926;[4] Evans, 1931;[5] Turner and Reynolds, 1931[2]). Evidence that such an abscess developed in the case described here is twofold: first, the encephalographic appearances of a small space-occupying lesion projecting into the floor of the right temporal horn observed on January 20, and, secondly, the histological findings observed in the fragments of brain tissue obtained when this region of the brain was needled on January 29. The abscess must have been a small one, as it did not obliterate the temporal horn, nor did it cause more than a very slight degree of ventricular shift. It is significant that abscesses of comparable size and situation have been observed at post-mortem examination following cavernous sinus thrombosis (Evans, 1931;[5] Turner and Reynolds, 1931.[2]).

Rupture into the ventricles is of course a not infrequent complication of brain abscesses (Falconer, McFarlan and Russell, 1943),[6] and is usually fatal. Occasionally cases have been described in which this event has occurred with subsequent recovery, even in the days before sulphonamide therapy (Atkinson, 1934),[7] but the evidence given in support of these claims is generally circumstantial and open to criticism. In the case described, however, two facts strongly suggest that the temporal lobe abscess discharged into the ventricle at the time of the episode of acute meningitis commencing suddenly on January 29. The first is that the cell counts of the cerebro-spinal fluid within the right temporal horn and within the lumbar theca were both raised to approximately the same degree. Usually in septic meningitis the cell count of the intraventricular fluid is very much less than the cell count of the lumbar fluid (Merritt and Fremont-Smith, 1937).[8] In the case reported here the cell counts of 5,200 and 6,400 white cells observed in the right ventricular and lumbar cerebro-spinal fluids respectively were comparable, indicating that the fluid within the ventricle had been inoculated to the same extent as the fluid within the subarachnoid space. That the cerebro-spinal fluid was sterile on attempted culture is of little significance in view of the chronicity of the focal inflammatory process in the temporal lobe and the previous sulphonamide therapy. The second fact is that later a localized stenosis occurred in the posterior half of the right lateral ventricle. It is not unreasonable to presume that this stenosis was the result of a cicatricial contraction secondary to an ependymitis occasioned by the discharge and drainage of the abscess into the temporal lobe, for it apparently became stationary when the cerebro-spinal fluid reached normality.

This case appears to be unique in that it is the first case reported in the literature of recovery from both fulminating cavernous sinus thrombosis and intraventricular rupture of a cerebral abscess. Moore, Gardner, Bell and Tannenbaum (1942)[9] reported a possibly similar case in which the patient, suffering from septic cavernous thrombosis, developed a transient left hemiparesis some weeks after the administration of sulphathiazole; but detailed cerebro-spinal fluid studies were not made and no definite decision was reached as to the pathological basis of this complication, from which recovery occurred. It may be that with the extended use of sulphonamide drugs many more cases of cerebral abscess secondary to cavernous sinus thrombosis will be reported.

Acknowledgements.

I wish to thank Dr. C. G. Parsons, who was in charge of this patient at the Burntwood Emergency Hospital, for the clinical details prior to the patient's admission to a military hospital. I am also indebted to Lieutenant-Colonel G. O. Chambers, M.C., R.A.M.C., my Commanding Officer, for permission to publish this case, and to Brigadier Hugh Cairns, A.M.S., and Air Commodore C. P. Symonds, R.A.F.V.R., for their interest and advice.

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HIRSCHSPRUNG'S DISEASE.[1]

By RICHARD FLYNN,
Sydney.

S.M.D., A FEMALE, aged twenty-six years, consulted me on July 1, 1939, because of constipation. Its onset had been in early childhood, and, in her own words, "for as long as I can remember I have been taking aperients". She had had no operations, and except for measles and an occasional cold had had no illnesses. She had had occasional attacks of pain in the lower abdomen; her periods began when she was about thirteen years old. They were very irregular in onset and were always associated with a certain amount of pain. When she was eighteen years old they ceased for about three months. While she was at boarding school (when seventeen years of age) she began to experience "periodic attacks of pain associated with marked swelling of the abdomen and complete constipation". A dose of castor oil always moved her bowels and freed her of pain. She was examined when seventeen years old by her family doctor, who on account of her pale complexion suspected kidney trouble; but after examination of her urine said that her kidneys were quite normal and gave her a certificate of good health.

During the subsequent years the attacks referred to above became more frequent and more severe. The abdomen became very distended, she vomited and the dose of castor oil took longer to operate and to give her relief. In June, 1934, she had a very bad attack, and her doctor diagnosed it as a bad attack of colitis. He advised her to take a dose of oil every month and also a daily dose of "Kruschen salts", which she did. During the next few years the "attacks" became less frequent but more violent. She stated that she was never very energetic, but at this period she noticed that she became even less so and tired more easily. She stated that she was nearly always tired in the mornings and often felt quite lightheaded and dizzy. Her hands and feet used to swell and during the winter months were covered with chilblains and cuts. Every year, she stated, she was confined to her bed on account of an attack of influenza.

The last of her periodic attacks, which was also the worst, occurred in March, 1938. Her description of her periodic attacks was as follows: "These attacks always began with swelling in the upper abdomen. The pain was intense, and in the more recent attacks it took twenty-four hours for the castor oil to operate and give relief." After the attacks were over she was always greatly exhausted. If by accident she omitted the daily dose of salts the bowels did not move. The most difficult time was each month when the periods were due. On frequent occasions she had noticed blood in her motions.

On examination the patient appeared to be a well nourished woman who did not appear to be in any pain. Her face was pale, but she did not have that waxy appearance of the skin, the lost eyebrows or hair that one would expect in a myxœdematous patient, but something about her suggested such a diagnosis. Her general examination revealed no abnormality except that her abdomen was more tympanitic than usual. Blood pressure was normal. The following investigations were carried out.

A basal metabolic rate estimation was carried out on August 8, 1939; the report of the biochemist was -30%. So as to raise this before operation she was given two grains of thyreoid extract three times a day, and a progress estimation on August 18, 1939, showed the basal metabolic rate to be +16%.

Her urine contained neither pus nor sugar. Calcium oxalate crystals and an occasional epithelial cell were found in the urine, and Gram-negative bacilli were grown on culture. The blood count showed an erythrocyte count of 3,780,000 per cubic millimetre, hæmoglobin value of 61% and a colour index of 78. The white cells were normal.

Radiographic investigations were carried out. On July 18, 1939, a barium enema was given and the radiographer's report was as follows: "The large bowel was filled as far as the distal portion of the descending colon. The visualized bowel appeared quite regular in contour, but was extremely dilated. It was not possible to fill the entire colon " (Figure I). A barium meal was given two days later. Most of the meal was still in the caecum and ascending colon, though some barium had reached the descending colon. There were no signs of obstruction.

A few days later the barium enema was repeated and on this occasion the colon was filled. The radiograph (Figure II) shows the enormous size of the colon, which is enlarged not only in transverse diameter but also longitudinally. The patient was asked to empty her bowel, and a radiograph showed the patient's almost complete inability

[1] Accepted for publication on February 18, 1943.

to empty the bowel; so a spinal anæsthetic was given and the bowel emptied itself.

To be sure that there was no associated lesion in the urinary tract, an excretion urogram was asked for. No abnormality was found.

A diagnosis of Hirschsprung's disease was made and operation was ordered. At operation on August 25, 1939, through a long left paramedian incision the lumbar splanchnic nerves on both sides were divided, and a Rankin obstructive resection

FIGURE I.

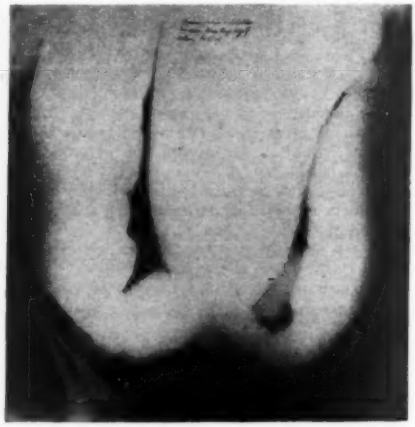

FIGURE II.

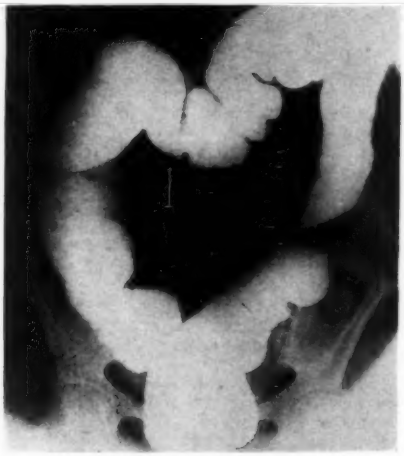

FIGURE III.

FIGURE IV.

was done on the sigmoid colon. A stab wound was made on the left iliac fossa and the sigmoid was carefully drawn through this wound. On account of the large diameter of the bowel, instead of Rankin's twin bladed clamp, two stomach clamps were applied, and the sigmoid loop was amputated. After the clamp had sloughed off, the spur was crushed and the patient was allowed to go home to recuperate. She returned to hospital for closure of her colostomy on February 13, 1940, and on March 16, 1940, a barium enema was given. (The appearance is shown in Figure III.) After evacuation, a further radiograph was taken, which showed the marked improvement in evacuation (Figure IV).

A recent letter from the patient assures me that she is very well and that she has a daily bowel movement.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

THE TREATMENT OF MASSIVE AND RECURRENT BLEEDING FROM DUODENAL ULCER.

E. Seifert: "*Die Behandlung der Massen- und Dauerblutung bei Ulcus Duodeni*", *Deutsche Zeitschrift für Chirurgie*, Volume cclv, page 20.

CLINICAL estimation of severe hæmatemesis makes little differentiation between gastric and duodenal ulcers as the source of the hæmorrhage. The clinical picture and the lines of conservative therapy are similar in both. Both are equally menacing to the patient's safety, and in both the tendency to recurrence is of importance both to prognosis and treatment. Medical treatment is often successful, but it is essential that some accurate estimation of its likelihood of being successful in any individual case should be possible. In all arguments as to the relative success of medical and surgical treatment there remains admitted the fact that in a number of cases only a properly timed operation will save the patient's life; and Seifert's plea is that the more menacing cases of ulcer hæmorrhage should not be passed on to the surgeon only "when medical treatment has failed".

There is no doubt as to the value of well planned conservative medical treatment, particularly according to the principles of Meulengracht, in tiding the patient over an emergency and enabling him to reach a position in which the decision for or against operation can be decided deliberately and at leisure. And this possibility has been greatly increased with the development of blood transfusion, whether this has, as many believe, a direct hæmostatic effect or not. Only very recently too, German medical literature has given expression to the view that the age of the patient is an important factor in prognosis in cases of gastric hæmorrhage treated conservatively, the age of forty being a sort of boundary stone beyond which the prognosis is definitely more grave.

With regard to surgical treatment, the question nowadays is not so much "whether" as "when" one should operate, and in this respect there is as yet no unanimity. The textbooks still state "when medical treatment fails"; while Finsterer, out of his own great experience, says "when possible operate in the first twenty-four to forty-eight hours". Lately, however, Finsterer himself appears to be modifying this attitude. The rule at present adopted by Seifert is: in severe first hæmorrhages or prolonged recurrent hæmorrhages, in cases in which an ulcer can be assumed without reasonable doubt to be the exciting cause, Meulengracht's method of feeding and blood transfusion are used. In this way the patient can be brought out of danger and rendered fit for deliberate surgery, for which purpose a hæmoglobin value of not less than 40% to 50% is considered necessary. Should the ulcer be gastric in position, operation is then undertaken. In other cases further measures for diagnosis or therapy will be carried out. Even Finsterer now refrains from early operation in young patients unless there is a previous ulcer history. In older patients he makes an exploratory incision under local anæsthesia, believing this to be less dangerous than further delay. Seifert, however, emphasizes the dangers of early hurried operation even in these patients. He records two cases, in one of which later more deliberate operation revealed a totally unsuspected cause for the bleeding which almost certainly would have been missed in an emergency exploration; and in the other an emergency operation undertaken without proof of the presence of an ulcer proved to have been unnecessary, as no ulcer was found.

When surgery is decided upon, there is no longer any doubt as to the nature of the procedure advisable. It must be the resection of the ulcer-bearing structure. All other procedures should be abandoned, and this holds for duodenal and gastric ulcers alike. The condition of the patient will nearly always necessitate the use of local anæsthesia. It is not often that the portion of the duodenum which bears the ulcer is not resectable, but it may happen so, and in such a case it is necessary that an alternative procedure should be ready in one's mind to be applied. Under-running of the main vessels leading to the ulcer is not practicable in all cases, while gastro-enterostomy, even associated with exclusion of the pylorus, will lead to arrest of the hæmorrhage in only a few fortunate cases.

Finsterer added to this procedure in five cases the pressure of a gauze pack applied so as to press on the ulcer and was successful, and others have reported successes achieved in the same manner. Seifert, following a published work of Reschke's, has

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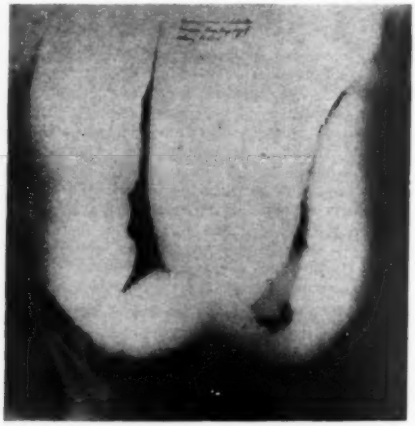

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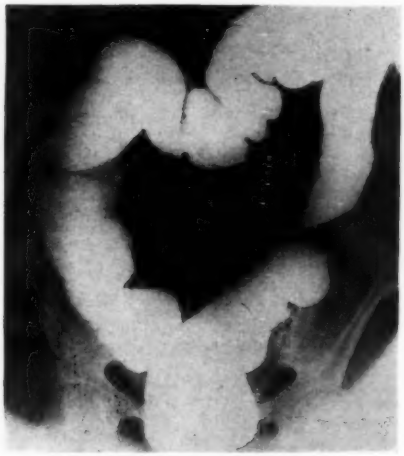

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treated these difficult cases in which the source of bleeding in the duodenum was inaccessible, by infolding the cut duodenal end, purposely left long, so that it acted as an internal tampon within the lumen of the bowel. In all three cases in which he did this, the effect was immediate and satisfactory. A fourth case similarly treated, in which however the patient died from pneumonia on the fourth day, gave valuable evidence at the autopsy, where the œdematous infolded end of the duodenum was seen to be exerting effective pressure on the actual ulcer. On the strength of these four cases, Seifert expresses the firm opinion that where resection of a duodenal ulcer is not possible, the bleeding can be stopped by section of the duodenum and the infolding of the cut end.

ARTHUR E. BROWN.

Reviews.

A New Conception of Keratoconjunctivitis Sicca (Keratitis Filiformis in Hypofunction of the Lachrymal Glands). By HENRIK SJÖGREN, with a foreword and appendix by J. BRUCE HAMILTON; 1943. Sydney: Australasian Medical Publishing Company, Limited. 9¾″ × 6″. Pp. 152, with illustrations. Price: 25s.

SJÖGREN'S monograph was published in the original German in 1933. Dr. J. Bruce Hamilton has now made it available in English.

After a preliminary historical survey the author discusses the clinical findings in nineteen cases of *keratitis sicca* observed over a period of three years. In twelve of these histological examinations of the diseased tissues were made. Although in all cases the lachrymal secretion was found to have been completely or almost completely abolished, the eye was always found to have been covered with sufficient fluid to protect it from desiccation. In the absence of normal secretion from the lachrymal glands, the conjunctiva was compelled to provide the entire amount, with a consequent chronic œdema of that membrane, gradually leading to hydropic degeneration and atrophy of the conjunctival and corneal epithelium. Atrophy of the glandular parenchyma with fibrosis was demonstrated in both the lachrymal and salivary glands, the change being more marked in the former.

Sjögren gives full details of his methods of clinical investigation. To demonstrate lesions of the corneal and conjunctival epithelium, he finds a 1% aqueous solution of bengal rose more helpful than fluorescein. Whilst fluorescein has an affinity for spots more or less denuded of epithelium, bengal rose, like methylene blue, is a "vital" stain—that is, it stains the nucleus of dead epithelial cells deeply and the protoplasm diffusely.

In cases of *keratitis sicca* the bulbar conjunctiva in the palpebral aperture stains an intense red, leaving the rest of the conjunctiva unstained.

The author also discusses Schirmer's test for the estimation of the amount of the lachrymal secretion. Schirmer described two methods: one without stimulation of the lachrymal gland, the other with reflex stimulation of the lachrymal gland by brushing the nasal mucous membrane with a camel-hair brush after application of 4% cocaine to the conjunctival sac. Sjögren supplements the second test with the fumes of ammonia.

In the foreword, the translator suggests that a further investigation might be made of the arthritic changes, and that periodical blood counts and estimations of the sedimentation rate might be made during and after exacerbations. He also suggests an investigation into the associated changes in the salivary glands.

In the appendix he gives his own experience in the treatment of three cases. From this he draws the tentative conclusion that *keratitis sicca* may occur in two forms. In one there is a true desiccation of the cornea, with or without filaments; this responds to occlusion of the canaliculi and to frequent instillation of artificial tears. The other, in which there is an intermittent vesicular keratitis associated with attacks of acute arthritis or parotitis, is not relieved to the same extent.

Dr. J. Bruce Hamilton is to be congratulated on a very readable translation of Sjögren's valuable monograph.

Architectural Principles of Arthrodesis. By H. A. BRITTAIN, M.A., M.Ch., F.R.C.S.; 1942. Edinburgh: E. and S. Livingstone. 9¾″ × 6¾″. Pp. 143, with 144 illustrations. Price 21s. *plus* postage.

IN this small book H. A. Brittain discusses briefly the causes of failure of fusion of joints after operations designed to bring about ankylosis. He stresses the importance of planning operations with due regard to correct mechanical principles, and illustrates these principles by means of sketches of cathedrals, hanging lamps and aeroplanes. Some of the illustrations are apt, some not so apt. There follow chapters dealing with

the problems of fusing by operative measures most of the joints of the limbs and sections of the spinal column. The various procedures are illustrated freely, and at the end of each chapter are reproductions of skiagraphs of joints to show the results.

The operation for spinal fusion is interesting and should be very useful, particularly in the dorsal region. The procedure described for fusing the ankle joint should succeed in the great majority of cases. The operation on the knee joint is not so convincing.

In regard to the hip, the author's operation, which is stated by Dr. Platt in the foreword to be his most notable contribution, is a modification of Trumble's arthrodesis by means of an ischio-femoral graft. It differs from the latter mainly in that the shaft of the femur is divided at about the level of the lesser trochanter and the graft is driven through the gap into the ischium. Whilst in some respects this procedure would appear to have certain advantages, occasionally the fragments might fail to unite and the patient's plight would be worse than ever.

Surgeons will find much of interest in this book, which is well printed and illustrated.

Demonstrations of Physical Signs in Clinical Surgery. By HAMILTON BAILEY, F.R.C.S. Eighth Edition, 1942. Bristol: John Wright and Sons, Limited. London: Simpkin Marshall (1941) Limited. 8¼" × 5¼". Pp. 348 with 455 illustrations. Price: 25s. net.

HAND in hand with the very great advances in surgical diagnosis which have taken place in the last two decades—advances in which much greater accuracy has been attained by the use of X-ray, laboratory and instrumental methods—there has been a gradual jettisoning of the painstaking clinical observations and the inductive and deductive clinical reasoning which served so well our forefathers. If a student is asked how he purposes to make a diagnosis in a particular case, he is most likely to answer that he will use some X-ray, laboratory or instrumental method, when a clinical history and examination and some time taken in assembling the information and reasoning out its import would almost certainly enable him to make the diagnosis.

As a corrective to this tendency many books have been written, but few which have been published in recent times have done more to remedy this state of affairs than Hamilton Bailey's "Demonstrations of Physical Signs in Clinical Surgery". This book, first published in 1927, has deservedly reached its eighth edition; and not only must the author but also the publisher be congratulated for its "resurrection"—as the author calls it—for its blocks were destroyed by enemy action and its reprinting was carried out in Bristol by John Wright and Sons under the most disadvantageous conditions.

Additions in this edition comprise paragraphs on the location of pain; on the tongue in relation to the patient's general condition; on some general principles in the examination of joints; on "spot" diagnosis; on blast injuries; and on thoracic wounds. There are many new black and white illustrations, all of which add greatly to the value of the bock. There are some very realistic new colour photographs of diseases of the tongue. "Thumb-nail" histories are advantageously used all through the book to amplify the portrayed clinical observations.

Altogether this edition is an improvement on its predecessors and must be regarded as an essential possession of every student.

Rose and Carless' Manual of Surgery (in two volumes). By CECIL P. G. WAKELEY, C.B., D.Sc., F.R.C.S., F.R.S.E., F.R.S.A., F.A.C.S., F.R.A.C.S., and JOHN B. HUNTER, M.C.; Seventeenth Edition. London: Baillière, Tindall and Cox. Pp., Volume I, 851; Volume II, 926; with 501 illustrations in Volume I and 599 in Volume II. Price: 35s.

DEDICATED to Lord Lister by the authors in grateful acknowledgement of the many advantages they derived whilst associated with him in his work at King's College Hospital, "Rose and Carless' Manual of Surgery" appeared first in 1898. Now, forty-five years later, its seventeenth edition appears, the authors of which are Cecil P. G. Wakeley and John B. Hunter, both surgeons of King's College Hospital. This famous English textbook thus largely reflects the surgical thought and practice of this great and historic hospital.

"Rose and Carless' Manual of Surgery" has deservedly been a favourite textbook of generations of students and the standby of legions of practitioners. For this there are valid reasons. By reason of its age and maturity and the accumulation of the thought and work of many famous English surgeons who have contributed to its many editions, there has accumulated in this work a wealth of filtered surgical knowledge. The work reflects the sound and logical teaching of the English school of surgery. And the present authors have carried on its traditions, added greatly to its worth and kept it abreast of all surgical thought.

In this latest edition, many advances in surgery and much surgical knowledge which has become important because of new methods of warfare have been included.

Chapters of special interest and value are those on hæmorrhage and shock, blood transfusion, war burns, blast, compression syndrome, abdominal surgery, radiotherapy and radium, anæsthesia. Perhaps one of the most important additions is that on war surgery.

A feature of this edition is the great number of beautiful and instructive illustrations by Mr. A. K. Maxwell.

The publishers are to be congratulated on the fact that, notwithstanding wartime difficulties in publication, the two volumes of this edition come up to the high standards of production of previous editions. This classical English textbook must be regarded as an essential reference book not only for students and general practitioners but also for those in the medical branches of the fighting forces, for the emergency medical service, and for those who are about to join up.

A Short Practice of Surgery. By HAMILTON BAILEY, F.R.C.S., and R. J. MCNEILL LOVE, M.S., F.R.C.S.; Sixth Edition; 1943. London: H. K. Lewis and Company Limited. 8¼" × 5¼", pp. 1062, with 922 illustrations. Price: 30s.

FIRST published in 1932, "A Short Practice of Surgery", by Hamilton Bailey and R. J. McNeill Love, has reached its sixth edition.

There are many reasons why this work has been of special service to students and practitioners. The authors have written from an experienced teaching point of view: they eliminate confusing completeness, and richly signpost the letterpress, giving perspective by relegating unessential or post-graduate knowledge to small type. They have made the book easy for a student to understand and have compassed a great amount of information into a thousand pages. Small illustrations, colour photographs, blackboard sketches, microscopic slides, X-ray photographs, tabulations, illustrations of anatomical preparations and of pathological specimens are profusely used and intimately related to the text; there are over 900 of these small illustrations. The authors have, too, kept the work up to date: in each edition the text has been revised, advances which have taken place since the last edition have been incorporated, matter has been deleted, new illustrations have been added, and old ones continually replaced by better. And in this present edition the same practice has been followed. A feature new to this edition is the inclusion of a glossary of anatomical names. This is intended to prevent any confusion which might arise as a result of different nomenclature. "Brief historical notes at the foot of many of the pages help to excite the reader's interest and give some personality to names which have been quoted that without these would be meaningless."

The colour photographs deserve special mention. Most of them are beautiful and most realistic, as, for instance, the photograph of a carcinomatous ulcer of the stomach on page 255: one might be looking at the actual specimen. As the authors state, these, with the wealth of other illustrations, shorten and lighten the text. Notwithstanding the fact that this edition has been produced in wartime, the publishers are to be congratulated that they have been able to keep up its high standard of production.

A Short Practice of Orthopædic Surgery. By T. P. MCMURRAY, M.B., M.Ch., F.R.C.S.: Second Edition; 1943. London: Edward Arnold and Company. 8¼" × 5¼", pp. 443, with 191 illustrations. Price: 30s. net.

THE second edition of this most convenient sized volume will be welcomed. The author has, as he states in his preface, tried to keep the book from growing larger with alterations and additions. He is to be congratulated on his success. His avowed object is to provide the senior student and young surgeon with information on basic principles. The practising orthopædic surgeon may find the manner of presentation rather dogmatic. This is inevitable in a book of its size which deals with so much in so little space. For those for whom it is primarily intended the absence of discursiveness is an advantage as they have the considered opinion of an accepted leader in orthopædic surgery presented without the confusion often caused by presentation of divergent views of several authorities.

The difficulty of retaining brevity without sacrificing something essential, however, is apparent, as for instance in the description of the operative treatment of *hallux valgus*. Two operations are described, the one favoured being "Keller's", although it is not named. The description given of the "Mayo" operation must be questioned, as it is stated to be "Removal of the Head of the 1st Metatarsal (Mayo's Operation)" [*sic*]. In the text the description is of removal of the whole metatarsal head. No mention is made of the interposition of a soft tissue flap. This operation is very rightly condemned by the author. It is certainly not Mayo's, and the whole description could very well have been omitted.

In the discussion of metatarsalgia there is no mention of the "digital neuroma" which was described by Betts, of Adelaide, and is now well recognized as a common cause of this distressing condition by Australian orthopædists.

In the treatment of claw foot there is mention of fasciotomy, Steindler's operation and tarsectomy, but none of the useful Lambranudi type of operation, which even in such a condensed volume is worthy of mention before going onto amputation of all toes and astragalectomy, which may easily be taken by the young surgeon as an accepted method of dealing with less severe forms of deformity than intended by the author.

Acute anterior poliomyelitis is dealt with so briefly that quite naturally there is very much left unsaid and many will join issue with some of the views expressed, as, for instance, the value of convalescent serum, massage (*per se*) and electrical stimulation. In discussion of splinting, the McNamara splint is not mentioned—in fact, the space devoted to the disease allows of only very meagre description of splinting, so meagre in fact as to be almost useless as a guide.

As in the first edition, the treatment of fractures is not included. The arrangement of the subject-matter is into twenty-five chapters. "Splints and apparatus" have pride of place instead of their usual back seat. This is very fitting, as it will help to impress their importance on students and young graduates, many of whom show lamentable ignorance of this phase of surgery, much to the discomfort of many a wounded soldier.

The illustrations are profuse, drawings, photographs and radiographs, all of which are well chosen and produced, the radiographic reproductions being refreshingly good.

Although the book is intended for the young surgeon, the most senior will find here a most useful summary of orthopædic conditions and of the methods of treatment, whether conservative or operative, which have been found by the author to give the most uniformly good results. The work is a most valuable addition to the library of anyone interested in the subject or who may have to deal from time to time with orthopædic conditions.

A Manual of Pulmonary Tuberculosis (Part I) and an Atlas of Thoracic Roentgenology (Part II). By DAVID O. N. LINDBERG, M.D., F.R.A.C.P.; 1943. Springfield, Illinois: Charles C. Thomas; London: Baillière, Tindall and Cox. 9¾″ × 6¼″, pp. 247, with 44 figures in Part I and 145 plates in Part II. Price: $6.50.

THE author states in his preface that the purpose of this manual is to cover the practical phases of the subject of pulmonary tuberculosis with brevity and sequence. We must conclude that he has attained this object successfully.

The section describing general management of the patient in sanatorium is excellent, and brings home to the uninitiated the minute care which should be exercised in these institutions in the supervision of rest as a measurement of exercise. The more modern methods of adding to this fundamental rest are well and simply described and not unduly emphasized.

Allowing for the difficulty of reproducing satisfactorily röntgenograms of the lungs, the atlas presents also a useful collection of examples of pulmonary abnormalities —once one has got used to the peculiar manner adopted of printing them back-to-front, thus viewing them from the posterior aspect, instead of anteriorly. The author, in spite of this, persists in the common, but deplorable, habit of referring to lesions as "subclavicular", adhesions as "in the right second anterior interspace" *et cetera*, when many such lesions, as a matter of fact, are situated at or near the posterior thoracic wall.

The lateral view is strangely neglected, even to the statement that "the lower border of the lung is well below the crest [of the diaphragm], as may be demonstrated with the use of radiopaque substance such as iodized oil"!

The statement on page 15 that "the conventional postero-anterior chest film, when interpreted as being within normal limits [*sic*], constitutes the complete X-ray examination necessary for the discovery of pulmonary tuberculosis", whilst obviously not to be taken literally, is also rather too sweeping. In the case of very early parenchymatous involvement the latter will show probably only in the postero-anterior film, but the necessary density of and contrast in the latter are highly "critical", and at least two such films of different density and perhaps with differing angle and level of tube are desirable. Then, again, many cases of early tuberculosis cannot be established, even presumptively, at a single examination, but need at least two sets of films, with an interval of at least some weeks between them.

It also seems a rather dangerous assumption that all calcifications or other unusual shadows that appear in the film in the vicinity of the hilar shadow are, as a fact, in the hilum, without lateral views being taken to see whether they are not, perchance, in the respective lower lobe apex, far behind the hilum. It is strange how this habit of thinking two-dimensionally persists in the study of (postero-anterior) chest films.

Only one lateral film and one oblique is reproduced in the whole atlas; and there appears to be no attempt at lobar localization of the various pathological areas.

In the elucidation of advanced changes both postero-anterior and lateral films are essential, and it is common knowledge—or should be—that the lateral view is, more often than not, much more revealing than the "conventional postero-anterior".

Perhaps the most interesting of the illustrations are those of the "tomographic" films—or "planigrams"—giving cross-sectional views of the lungs at various depths. Here again, however, the respective lateral view, combined with the postero-anterior, will give, in most cases, all the necessary information.

Minor omissions may be noted; for instance, neither Boeck's sarcoid nor moniliasis is illustrated, though both are mentioned under "Differential Diagnosis" on page 14.

The text of the manual ends rather abruptly on the question of control of bovine tuberculosis, and dismisses this important question by stressing unduly the testing of dairy herds and the elimination of reactors, adding "the use of pasteurized milk provides an additional safeguard". Surely the emphasis should be laid on the provision of a properly pasteurized, bottled milk supply. Altogether, however, Dr. Lindberg's book, while hardly suitable for the undergraduate, can be recommended strongly to that harassed individual "the busy practitioner".

Blood Groups and Transfusion. By ALEXANDER S. WIENER, A.B., M.D.; Third Edition; 1943. Springfield, Illinois: Charles C. Thomas. London: Baillière, Tindall and Cox. 9¾" × 6¼", pp. 457, with 69 figures. Price: $7.50.

THOSE familiar with Wiener's writings in the journals and with the earlier editions of his book will turn with confident interest to this up-to-date new book on the blood groups.

The author is a master of teacher English and consequently makes even the more abstruse parts of his subject very readable. Each chapter is a compact and admirable essay on its subject title. As the author points out, the last three years have witnessed a marked increase of interest in blood transfusion and in grouping owing both to the war and to the introduction of blood banks. Apart from the need for rewriting on these accounts and for new type in this larger book, two entirely new chapters have been added. One deals with the transfusion of stored blood and blood substitutes, and the other with the recently discovered Rh factor and its role in *erythroblastosis fœtalis* and in intragroup reactions occurring in some cases of multiple transfusions.

An account of this dramatic advance in our knowledge is set forth with great clarity. The relationship between the "Rh positive" father and fœtus and the "Rh negative" mother is shown and easily explained in the 90% of cases met with. Moreover, in the remaining 10% of cases of *erythroblastosis fœtalis* in which the mother is "Rh positive" information as far as present knowledge permits is given.

In such a complete book on blood transfusion the direct method is given full attention. The author places the method for unmodified blood transfusion into four categories: (*a*) multiple syringe, (*b*) paraffin-coated containers, (*c*) syringe-valve methods and (*d*) tube methods. He describes and illustrates them all in detail because he states that they are all still in use; but he tacitly implies that the first three should be abandoned in favour of the fourth, or tube method, because of its simplicity and reliability.

In this opinion we are in hearty accord, mainly because of recent work with the twin roller rotary pump and tubing, which shows complete and unfailing success over a period of three years in a large number of cases in Australia.

To those readers who have an interest in heredity and the evolution of blood groups and the light thrown upon it by the study of blood groups in vertebrates from apes and monkeys downwards, the book will prove a very mine of information.

Equally satisfying will be found the chapters on blood differences as they bear on questions of parentage and on medico-legal aspects of blood stains and so forth. Even the mathematically inclined will find good hunting in several chapters.

Apart from all this, the essential chapters bearing on blood groups, sources of error in grouping, selection of donors, survival of cells in the recipient, reactions and complications, and, further, the general management of transfusion of stored blood, plasma and serum, are a shining example of good writing combined with accurate and helpful content. The book, therefore, which from cover to cover contains no wasted words, may be regarded as a standard work of reference for all, authoritative, practical and complete.